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The Illumination of Interiors

At the recent convention of the Michigan Section of the National Electric Light Association a paper was presented by Mr. M. Luckiesh on the fundamental principles of interior illumination. Some valuable experimental data are given in the paper, which deals with the quality, effectiveness and distribution of interior artificial lighting, as well as with the esthetic effects produced. Some of the pleasing effects of good interior illumination can be traced directly to normal physiological influences. On the other hand, there are some effects of an esthetic character which cannot yet be traced to their source. That is to say, they may be due to physiological actions, or to mental habits, or to obscure physical and physiological interactions. While these outstanding unexplained phenomena may serve to interest future investigators for some time, enough is already known to make clear what good interior lighting requires.

Meters for the Small Consumer

The current-limiter and maximum-demand-meter situation in this country needs attention, and that very soon. The manufacturing companies get plenty of blame from the meter men because they have displayed little energy in developing good devices of this type. It is well known that, from the standpoint of modern accurate metering, the old Wright instrument is hardly more than an indicator. Some very fine types of curve-drawing instruments are available, but these are too expensive for small installations. Certain other combinations of clocks, motors, meters, printing devices, etc., have been in a process of development, and even at present are giving good service where the expense of installation and attention is warranted, but they are, strictly speaking, not yet on a commercial basis. One form of instrument which earlier gave much promise is now found to be accurate only on a steady load and reads as much as 25 per cent high or low upon different shaped peaks. In Europe the maximum-demand meter has been developed to a much greater commercial extent than in America, but, as usual, it is not feasible or advisable to imitate, without considerable modification, the practice of the old world. Before railing too much at the manufacturers, however, the meter men and managers should pause. It would seem as if something must be done by them first. As a matter of fact, there is a very serious difference of opinion as to what is wanted, and in view of the enormous expense of development and the simultaneous demand for a low-priced meter when it does come, manufacturers can hardly be blamed for not rushing ahead until they know what will be acceptable. Simultaneously with the demand for a cheap and accurate maximum-demand meter from some quarters comes a demand for a cheaper watt-hour meter or even an ampere-hour meter. Even the cheapest meter that can be hoped for will increase the present cost of installation on the consumer's premises, and this is opposed to logical commercial development. The matter of meters has been referred to in reports of committees of the National Electric Light Association and the Association of Edison Illuminating Companies, notably at the convention of the latter association. The Wisconsin commission postponed its action on the subject for a year pending suggestions from the joint meter committee of the above associations. The matter is, therefore, receiving attention, but before committees or commissions can act intelligently these fundamental questions must be widely discussed and answered as well as they can be. Commissions in particular need much information if well-advised regulations are to be issued. To solve the problems properly involves a consideration of the very fundamentals of the conduct of electricity supply and sale. Such large subjects should be discussed fully by all societies interested in electrical development.

Electric-Vehicle Charging Stations

In his address upon electric vehicles at the recent N. E. L. A. convention Dr. C. P. Steinmetz reflected a fine optimism. It is undeniably true that there is a demand for a type of vehicle of minimum operating cost, suited for ordinary local business or pleasure service rather than for miscellaneous touring and heavy mileage over long distances. That the electric car has many of the qualities to fit it for filling this particular need is thoroughly well understood. As to the ideal car to which Dr. Steinmetz is looking forward, we earnestly hope that the weight and cost will not be more than double the figure he indicated and that the mileage will be at least as great as that to which he looks so hopefully forward. There are rumors of cheap and good electric automobiles about to appear, rumors which we hope will materialize in time to maintain Dr. Steinmetz's reputation as a prophet. Be this as it may, one point of the address we desire to emphasize in a way to leave no doubt about the situation. In the use of the electric vehicle, be it runabout or truck, it is of paramount importance to have a sufficient number of available charging stations to meet with the requirements of those who wish to cover more than trivial distances. The present understanding is that

so far as the light and small vehicles are concerned there will probably be available in the very near future portable charging sets capable of being tapped into available lighting circuits. Such a device would meet a long-felt want for home charging purposes, but for the rapid recharging of the more powerful pleasure vehicles, and especially trucks, it is necessary to have available charging stations at a very great number of points, so widely distributed that a charge can be obtained as readily as gasoline. The central-station industry must make the electric car practicable by furnishing ample facilities for charging here, there and everywhere, at a modest rate for energy. Even the most optimistic friends of the electric vehicle realize that its radius of action is short and that the cost of energy in most places is high as compared with analogous accommodations for the gasoline car. Much may be done to popularize the electric vehicle by providing cars of the description to which Dr. Steinmetz made reference, but the main factor in the electric-vehicle situation is not so much the excessive cost and weight of the cars now available as the great difficulty of getting them charged at the time and place of necessity. A foolproof automatic charging system available on one's own premises or operable from roadside taps as common as gasoline stations is the chief desideratum for the immediate future.

Commissioner Erickson on Reasonable Return

Many are in danger of forgetting the connection between regulation and reasonable returns. The public and the companies sometimes make the mistake of thinking that regulation means unreasonable returns. The keystone of regulation, as Mr. Erickson showed in his paper before the Michigan Section of the N. E. L. A., of which an abstract is published in this issue, is fairness to all interests. It cannot permit unreasonably high returns. It cannot enforce unreasonably low returns without arresting development. In discussing the subject most people confine themselves to argument and avoid actual figures. Mr. Erickson, however, has expressed himself on both points. The rates that he quotes apply apparently to securities of established public utility properties.

All doctrines, theories, hopes and fears are controlled by the very practical question of what rate it is necessary to pay to obtain the money. Borrower A does not have to pay the rate that Lender B demands; he does have to pay the rate that supply and demand fix for all the money loanable for his purpose, taking into account risk and convertibility, at a given time. The experiences of Mr. Erickson lead him to say that in public utilities, "even under favorable circumstances, it is not safe to assume that interest and profits will require less than 7.5 per cent on the fair value of the plant and its business." If this is the rate under favorable circumstances, what would it be where the risk of loss was high and the chance of profit low? What would it be for a new utility in an untried community?

As factors bearing upon his conclusions Mr. Erickson considered the tendency and course of prices for commodities and labor as well as for money. That labor and material costs have moved upward is too plain for argument. Unless the return for capital is to be impaired the extra costs have to be included in the cost of service. Some of the extra costs have been overcome by increased economy and efficiency in operation; some have disappeared with the natural growth of business and the accompanying reduction in expenses per unit of output. But the problem as a whole cannot be overcome in all communities by dependence upon these factors. Unfortunately, as Mr. Erickson says, "many rates made a few years ago, not only by commissions, but by the utilities themselves, are now too low." Where rates are too low, is a full revelation of that fact a sound and sufficient reason for an increase? We should like to say that it is. But candor forces the admission that rate-making is so seriously afflicted with considerations of public policy that authority for increases comes slowly and reluctantly from public authorities. Witness the long, weary wait of the railroads for relief from the Interstate Commerce Commission. When there is any other possible remedy the authorities do not act.

Commissioners are public office-holders and they hesitate to act in what they fear may be the face of a certain hostile public sentiment. If they do not have public support, they will lose influence and office and the policy of regulation will die. The course for companies to follow if their rates are inadequate is to try to get the public to see the facts. If they can get the support of public sentiment, they have an argument as strong as the facts themselves. There is much hope for the cause of the utilities when a member of a commission of the standing of Mr. Erickson will admit that there are many cases where rates are too low.

The Electrically Driven Gyroscope

Inertia is one of the great influences or natural laws controlling the universe in which we live. It may be defined as the energy equivalent of change in motion. Energy must be put into matter to change its motion. No change can occur without work to pay for it. On the other hand, as a compensatory principle, work so done must inevitably produce a corresponding change of motion, and such changes of motion, if reversed, release the stored-up energy.

In the gyroscope a relatively large amount of energy is stored up in the rapidly rotating heavy wheel. This energy may be regarded, in a certain sense, as vector energy, since it is associated with angular momentum about an axis. If now moderate twisting forces are allowed to do work on the gyro about some other axis, the amount of vector energy added with reference to the axis of application will be small compared with that contained with reference to the original axis, and will result in a vector summation which

will place the final resultant vector energy at a new axis slightly displaced from the original. The process of shifting the axis, in obedience to the vector summation, is called precession. The precession of the ordinary gyro-top is one of the most fascinatingly amusing phenomena for captivating the interest of old or young observers. The spinning top, as a crude form of gyroscope, has charmed many generations of boys, but only to the last generation has the spinning top revealed its wonderful latent powers of holding a vector axis fixed in space indefinitely regardless of surrounding motion-chaos. A gyro-compass on board a ship is started, say, in Boston, with its axis pointing north. The ship crosses the Atlantic, and for a week jumps and curvets in a bewildering dance of motions to the music of the waves; yet the gyro never swerves from its allegiance to the earth's axis by more than a fraction of a degree.

The ordinary spinning top gives but a glimpse of its latent possibilities in holding a direction because its stock of rotary energy is small and short-lived. It was not until an electric motor was harnessed to a heavy and finely balanced top that the real powers of the gyro in this respect became apparent. The larger the stock of vector rotary energy, the smaller the vector deviation due to casual disturbances. The modern gyro-compass gives far more directive torque than the best magnetic compass and ignores magnetic disturbances and declinations. It points to the true geographical north.

The gyro-horizon gives an artificial true horizontal on the deck of a rolling ship. The gyro-stabilizer helps an aeroplane to hold its direction, or a ship's hull to hold its course, in spite of winds or waves. An interesting description of the Sperry gyro-compass is given in the paper by Mr. H. C. Ford, presented at the Detroit convention of the American Institute of Electrical Engineers. One may confidently expect a large future for the commercial gyro in aeroplanes and on seagoing vessels.

Lessons from German Central Stations

An interesting study of the development of central-station work in Germany was outlined recently in our Digest. The statistical information regarding the German electricity works has been very carefully worked out, and the results of a study of the data thus obtained lead to some important conclusions. They are directly in line, too, with the trend of practice in this country, but give perhaps a somewhat fresh viewpoint regarding the economical side of central-station development. The data available show that there were in Germany in 1913 between 3500 and 3600 central stations of one sort or another. Of this total number about 3100 were rated at 500 kw or less; 103 exceeded 5000 kw. This reckoning is probably not absolutely complete, but it is sufficiently so for the purpose of comparison. Within the last ten years nearly 2300 stations of less than 500 kw have been put into operation, while nearly seven-eighths of the big stations mentioned have been built within the same period.

The striking feature of the situation is that the available data show that a little over three-quarters of the total rated capacity in the empire lies in this modest list of stations exceeding 5000-kw rating. What is of even more importance from the economic standpoint is that the unutilized equipment in these stations—that is, the difference between the aggregate rating and the maximum load carried—is greater than that of all the other central stations combined. In other words, if the whole electricity work of supply could be turned over to the hundred or so large stations they would have more than enough equipment to do it all. Meanwhile, in the last ten years nearly 2300 of the little stations have been installed at an aggregate cost which may be reckoned at not less than $25,000,000. In other words, $25,000,000 has been spent in providing station equipment which from the standpoint of aggregate output is unnecessary and represents to a considerable extent lost investment. This is a most striking bit of evidence in favor of that larger central-station work which is characteristic of electrical supply in our own country. Save in rare instances, there is little need now of building small stations carrying an unwarranted cost per kilowatt of equipment and an excess cost of operation, when existing stations working at the highest point of economy are available to do the work.

Of course, in certain instances it happens that a small plant is desired at an inconvenient distance from one of the larger ones, or, if within reach, local conditions may temporarily make it commercially undesirable to depend on the supply of energy from outside. Putting away such somewhat unusual situations, it is perfectly safe to say that in the majority of cases here, or in Germany or anywhere else, it does not pay to run a station of, say, 500 kw or less when energy can be purchased from a large and economical station within striking distance of the field to be supplied. More and more the large hydroelectric systems of the country are becoming wholesalers, delivering energy to the local distribution companies for sale to the ultimate consumers. The German data show clearly the wisdom of this course. Why should 100 stations have surplus equipment enough in the aggregate to supply all the other stations of the country and yet not have the opportunity of doing so? Of course, occasional instances arise where the loads of two adjacent stations may not fit conveniently to secure the best of economy of operation, but for every such case there are a score where the gain in diversity-factor is a very material one, so that instead of requiring considerable spare equipment in the large stations to take care of the little ones, the former might really be able to handle the whole load without utilizing their full reserve equipment. It is an economic waste to burden a community with high investment charges where low ones, as for the building of the distribution network, will suffice. The chief thing to be desired is that the large station managers shall see, as they often do here, the economic possibilities of the situation and make wholesale rates low enough to obviate the unhappy necessity of establishing any more small and uneconomical plants.

The News of the Week

**Activities and Events in the Electrical Field—
Reports of Meetings—Commission Findings, Etc.**

New York's Fourth-of-July Illuminations

New York's city fathers have appropriated $25,000 for publicly celebrating the Fourth of July in a safe and sane manner, and of this amount $11,000 will be spent for electrical decorations in wiring the monuments and parks. The energy for all of the illuminations in Manhattan will be donated, as in previous years, by the New York Edison Company, and in the other boroughs by the local electric-light companies.

Manhattan Island and the greater city will be illuminated with 25,000 multi-colored lamps. Each borough will have its quota of decorative lighting according to the plans drawn up by the illumination committee, of which Mr. Arthur Williams is chairman. The schedule for Manhattan includes the lighting of the Sailors and Soldiers' Monument, the Mall in Central Park, where 3500 lamps will be used; Grant's Tomb, which will be outlined in red, white and blue lamps; a portion of Riverside Drive, the City Hall, and many other places and buildings. In Brooklyn a number of parks will be illuminated and the Brooklyn Edison Company will wire and light the Borough Hall without cost to the city. Other public parks and places will be illuminated in the Bronx, Long Island and Staten Island.

Inauguration of Cabin Creek Junction Plant

The new Cabin Creek Junction (Va.) hydroelectric station of the Virginia Power Company, which is designed to furnish energy to a territory covering about 1500 sq. miles, was recently put in operation. The station is laid out for an ultimate equipment of 166,000 hp, but only two turbine-driven generators, rated at 26,666 hp, are installed at present. By utilizing the water-power it is estimated that about 300,000 tons of coal will be saved per year if the plant is operating at its maximum output. About 125 miles of transmission line have been installed thus far, serving a number of mining plants. The initial operation of the station, which was in charge of Mr. G. O. Lenz, chief engineer, was attended by several capitalists and coal-mine operators. After witnessing the event, the party of visitors proceeded to White Sulphur Springs, where the Virginia Power Company entertained them at a banquet.

Gyroscope Stabilizing Device for Aeroplanes

The recent public tests at Bezons, France, of the aeroplane-stabilizing device invented by Mr. Elmer A. Sperry, of Brooklyn, N. Y., are reported to have been successful. While aloft in a machine, the inventor and his son are said to have left their seats, while the pilot abandoned his position at the steering wheel and climbed out onto one of the planes, the aeroplane meanwhile flying steadily under automatic control. In the stabilizing device use is made of four gyroscopes with their axes at right angles. It is possible to tilt the machine sufficiently to make turns safely, but the aviator cannot tilt the machine to a dangerous angle. The gyroscopes operate delicate valves leading to two servo-motors which control the planes and steering gear of the machine. The entire stabilizing equipment weighs 100 lb. and is operated by alternating current from a generator driven by the aeroplane engine. The device works so quickly and accurately that under emergency conditions the control is declared to be automatic. When the machine travels too slowly or rises at too great an angle the control becomes automatic and the machine volplanes to earth.

A. S. M. E. Discusses Boiler Standardization

At the meeting of the American Society of Mechanical Engineers in Minneapolis, Minn., June 16-19, national standardization of boiler specifications was discussed at length, the formal report occupying approximately fifty typewritten pages. As the outcome of the debate it was resolved that the committee on boiler specifications should hold a meeting on Sept. 15, 1914, in the rooms of the society, New York. Invitations will be issued to representatives of boiler manufacturers and steel-makers, foundrymen and others interested in boiler standardization. It is expected that the set of specifications to be evolved will meet the approval of the various state legislatures and municipalities throughout the entire country. At present there seem to be as many different boiler standards as there are legislative bodies. This condition has made those states and cities where specifications are most lax the dumping ground for boilers which will not pass the more rigid specifications in neighboring states and cities. It is hoped that the specifications will serve as a guide to state legislatures meeting in the fall.

Hewitt and Steinmetz Rectifier Patents

Four patents relating to mercury-vapor rectifiers issued on May 19 are of more than passing interest by reason of the early dates of applications and the developments disclosed therein. Three of the patents, having the titles "directional-current arrester," "single-phase directional-current arrester" and "method of electrical transmission," were granted to Dr. Peter Cooper Hewitt, whose applications were filed Oct. 30, 1902. The fourth was granted to Dr. Charles P. Steinmetz on a "vapor-rectifier system," the application having been filed Sept. 25, 1905. Selected claims from the three Hewitt patents are as follows:

"The combination of an exhausted envelope, multiphase electrodes for said envelope and supplemental means for continuously generating ionized vapor in said envelope."

"The combination of a source of alternating electromotive force, a vapor conductor, including electrodes in an exhausted receptacle, one at least of said electrodes being of vaporized material, and means in circuit with the vapor conductor for consuming current flowing from said source."

"The method of deriving from a source of alternat-

ing electromotive forces a flow of current in one direction, which consists in opposing a negative electrode reluctance to the flow of current in the opposite direction and maintaining a condition of low resistance in the desired direction due to a continuous impressed electromotive force in that direction."

One of the claims in Dr. Steinmetz's patents reads as follows: "The combination of a source of alternating current, a vapor electric device traversed by said current, reactances connected in shunt with said rectifier, a circuit connecting said reactances to the source of current and an impedance device in said circuit, proportioned to substantially prevent a discharge of said reactances through said circuit."

A paper by Dr. Peter Cooper Hewitt on "Electric Gas Lamps and Gas Electrical Resistance Phenomena" was published in our issue dated Jan. 11, 1902. An article on "The Mercury Arc," by Dr. C. P. Steinmetz, appeared in our issue of Feb. 21, 1903.

Convention of Electrical Contractors' Association

The National Electrical Contractors' Association will hold its fourteenth annual convention at Detroit, Mich., from July 14 to 18. A meeting of the board of directors and of the executive committee will be held on July 14. The following morning there will be an open session. Mr. E. McCleary, past-president of the association, will open the meeting. There will be addresses by Mr. John C. Gillespie, Mr. John Trix and Mr. W. N. Matthews, Jupiter of the Jovian Order. The Hon. John E. Kinnane, chairman of the Michigan Industrial Accident Board, will speak on "Workmen's Compensation and Employers' Liability." At noon a complimentary luncheon will be tendered by the Detroit Jovian League to the contractors and their guests, at which Mr. Robley S. Stearnes, statesman for Louisiana, will act as toastmaster.

In the afternoon Mr. T. I. Jones, chairman of the Commercial Section of the National Electric Light Association, will address the business session. A rejuvenation of the Jovian Order will be held in the evening at the Detroit Board of Commerce Building. In the afternoon of Thursday Mr. S. E. Doane, chief engineer of the National Lamp Works of the General Electric Company, will address the business session on "Observations of Central Stations and Contractors' Conditions in Foregn Countries." The annual dinner of the association will be held at the Hotel Cadillac on Thursday evening at 7 p. m., when Mr. L. W. Eddy will act as chairman.

Among the entertainment features for Friday will be an automobile ride, in charge of Mr. John H. Busby, scheduled for the morning, and a boat trip and outing arranged for the afternoon in charge of Mr. Thomas M. Templeton. The convention will conclude with various business and executive sessions on Saturday morning.

Water-Power Legislation

Representative Edward T. Taylor, of Colorado, leader of the opposition in the public lands committee of the House of Representatives to the program of government leasing of public resources, has announced that his minority report against the coal leasing bill will stand as his minority report against the "hydroelectric leasing" bill favored by the committee. A synopsis of the majority report filed by Representative James M. Graham, of Illinois, was printed in the *Electrical World* last week.

Representative Taylor said that the whole West is against the general leasing plan. "I am opposed to having the resources of the West withheld from private ownership and put into a general federal leasing system," he declared. "I do not like absentee landlordism. I object to the un-American policy of government by distant bureaus and renters who pay no taxes and are on the 'tenant-at-will' basis, with little or no allegiance to our Western States.

"What honest or fair-minded man can justify putting a federal tax upon the water-power of our non-navigable streams, which cost the government nothing, and putting no tax on the water-power generated by the navigable streams that cost the taxpayers of the entire country hundreds of millions of dollars?

"To me these paternalistic and centralizing tendencies appear little short of national bureaucracy run mad. Conservation has become a mania. I hope I may be mistaken, but this policy looks to me like a bold trampling upon the principle which lies at the foundation of our republican form of government.

"I have an abiding conviction that there are enough brains, honesty and patriotism in the West to regulate and control the public-service corporations; and if there is any question about it in any state at the present time, and until such time as suitable laws shall be enacted, the federal government can and should reserve the right to exercise a supervisory regulation of them whenever the local utility commissions do not perform their duty. In order to retain such control it is utterly unnecessary to impose a federal tax upon our development and at the same time prevent the going into private ownership and onto the tax rolls of hundreds of millions of dollars' worth of property. I look upon it as neither right nor necessary, but humiliating, for Congress to put the Western States upon the same basis as the Territory of Alaska, and thereby force us into a perpetual tenantry class, under the guise of regulating our development. I repeat that this is not a question of individual or of political parties, but one of governmental policy."

Anti-Trust Legislation

Senator Newlands on Tuesday reported his amended trade commission bill to the Senate, with a lengthy report which embodies the substituted bill and which goes into the history of the measure. His amended bill was brought from the Senate committee on interstate commerce as a substitute for the House bill passed June 5.

It is provided that the commission shall be composed of five commissioners with a regular term of seven years, but the terms are so arranged that the whole membership will not be subject to a complete change at any one time. The work of this commission will be of a most exacting and difficult character, demanding persons who have experience in the problems to be met —that is, a proper knowledge of both the public requirements and the practical affairs of industry. The salary proposed for each commissioner is $10,000 per annum.

One of the most important provisions of the bill is that which declares unfair competition in commerce to be unlawful, and empowers the commission to prevent corporations from using unfair methods of competition in commerce by orders issued after hearing restraining and prohibiting unfair methods of competition, which orders are enforcible in the courts.

The committee gave careful consideration to the question as to whether it would attempt to define the many and variable unfair practices which prevail in commerce and to forbid their continuance or whether

it would, by a general declaration condemning unfair practices, leave it to the commission to determine what practices were unfair. It concluded that the latter course would be the better, for the reason, as stated by one of the representatives of the Illinois Manufacturers' Association, that there were too many unfair practices to define, and after writing twenty of them into the law it would be quite possible to invent others.

It was stated that representatives of the National Implement and Vehicle Manufacturers' Association, the Ohio Manufacturers' Association and the Illinois Manufacturers' Association approved the passage of a trade commission bill and a provision regarding the inquiry into and condemnation of unfair practices in trade.

The committee said that the term "unfair competition" has a legal significance which can be enforced by the commission and the courts, and that it is no more difficult to determine what is unfair competition than it is to determine what is a reasonable rate or what is an unjust discrimination. The committee was of the opinion that it would be better to put in a general provision condemning unfair competition than to attempt to define the numerous unfair practices, such as local price cutting, interlocking directorates and holding companies intended to restrain competition.

In verifying the returns made by a corporation or in the conduct of such special investigations as the commission may deem necessary, it is indispensable that it should have extensive powers of inquiry, with the right to subpoena witnesses and to require the production of books and papers. The powers which, according to this bill, are granted to the commission are practically the same as those now granted to the Interstate Commerce Commission or the Bureau of Corporations, while the same constitutional protection is given to witnesses who testify as to matters which might incriminate them.

The consideration of Senator Newlands' measure on the floor of the Senate is likely to be delayed by the consideration of the rivers and harbors appropriation bill, which was reported on Thursday and will require a week's time for discussion.

Senators Brandegee, of Connecticut, and Lippitt, of Rhode Island, are opposed to the trade commission bill in its present form and will lead a fight against it.

Attempts to frame trust legislation, in other respects, in Washington during the past week have included a decision by the Senate judiciary committee to modify considerably the section of the Clayton bill which would legalize boycotting, blacklisting and picketing by labor unions. Also, the committee is asking the opinion of the Interstate Commerce Commission on Sections 2, 3 and 4 of the Clayton bill. There may be an attempt to insert these in the Newlands bill.

Section 2 of this bill prohibits discrimination in price between different purchasers of commodities in the same or different sections or communities, when these commodities are sold for use or resale within the United States, with the purpose or intention thereby to destroy or wrongfully injure the business of a competitor.

Section 3 makes it unlawful for the owner, operator or transporter of the product of any mine, oil or gas well, reduction works, refinery or hydroelectric plant producing coal, oil, gas or hydroelectric energy, or for any person controlling the products thereof, to refuse arbitrarily to sell such product to a responsible person, firm or corporation who applies to purchase.

Section 4 provides that it shall be unlawful for any person engaged in interstate commerce to sell, lease, fix a price or rebate upon such price on condition that the purchaser or lessee shall not use or deal in commodities of a competitor.

These ideas will meet with great opposition in the Senate in whatever form presented.

Senate lawyers who are members of the judiciary committee have found so many objections on constitutional grounds to paragraphs in the Clayton bill as it passed the House that they declare they are at a loss to know how to proceed. Headed by Senator Hoke Smith, of Georgia, some of them conferred at the White House Wednesday night with President Wilson, in an effort to gain his consent not to push the administration's proposed anti-trust legislation at this session of Congress, but they met with little success.

After Senator Newlands introduced his amended bill, some Senate lawyers expressed the opinion that paragraphs of that measure also are unconstitutional.

The sundry civil appropriation bill, which is now before the House, contains an item of $300,000 for the enforcement of anti-trust laws. This is an annual appropriation, and the item which caused President Taft to veto the sundry civil budget once because it provides that no part of this sum shall be used in the prosecution of farmers' associations and organized labor bodies. It is said in Washington that, in addition to this $300,000, when the new trust legislation passes it will be necessary to appropriate several times that sum to enforce the new laws, bringing the cost of enforcing the proposed anti-trust legislation up to an enormous total.

A. I. E. E. Convention at Detroit

With a registered attendance of about 350 the annual convention of the American Institute of Electrical Engineers opened at Detroit on Tuesday morning of this week. On Monday evening there was a reception and dance at the Hotel Pontchartrain, the headquarters of the convention.

President C. O. Mailloux, New York, announced as the subject of his address, which opened Tuesday morning's program, "The Evolution of the Institute and Its Members." He first gave a historical résumé of the accomplishments of the society and spoke of the spirit of readiness-to-serve actuating the great body of members. The work is not only done voluntarily, but men actually pay in time for the privilege of doing it. The Institute thus obtains without cost better service than it could hope to obtain for money.

Considering next the evolution of the organization, President Mailloux said that the field of the Institute is enlarging rapidly and in all directions. He spoke of the creation of new specialities in electrical work, some of which have attained the dignity of separate branches of engineering. These branches have even been recognized by the organization of separate societies, such as the American Electrochemical Society and the Illuminating Engineering Society. The creation of these societies was doubtless justified, but of the organization of some others there is a question, said the speaker. The work of the committees of the Institute is done by specialists and is backed by the whole Institute. The organization has a large field and a large audience, and it can perform most classes of electrical-engineering work better than can smaller societies. In a way the Institute is like a central station and its "diversity-factor" should be taken into consideration.

General Culture for Engineers

The concluding part of Dr. Mailloux's address related to the social and civic evolution of the members of the Institute. The necessity of engineers' building up the elements of general culture was emphasized. Mere technical adeptness and dexterity do not con-

stitute the sole end and aim of life. Engineers have not paid enough attention to their relations to the outside world. As a professional class they are entitled to a higher place than has been accorded them by the public. Tasks of social rearrangement are ahead of the body politic, and they provide a field of work where the technical training of the engineer should be almost indispensable. The lawyer, the politician, the agitator and the Utopian dreamer press forward, while the engineers hold back. There are too many "quacks" and not enough real physicians among the preachers on economics, declared the speaker.

The average citizen is untutored and needs the advice of experts. "Where shall he turn for leading?" questioned President Mailloux. "We need to go back to first principles," he continued. "We need to inculcate a taste for deeper thinking and better expression." No one class is competent to deal with all questions before the public. The engineer has learned the value of scientific methods. He should not place too conservative an estimate on himself. The members of the American Institute of Electrical Engineers should develop "class spirit." They should show that engineers are well qualified to discuss and deal with public questions. They must take a social plane parallel to those occupied by the older professional classes. The priest and the lawyer do not possess all of human wisdom.

At the conclusion of the president's address Mr. D. B. Rushmore, of Schenectady, N. Y., indorsed Dr. Mailloux's plea. The situation exists, he said, largely because engineers allow it to exist.

Mr. Farley Osgood, chairman of the convention committee, next told of the arrangements for golf, tennis, automobile rides, boat trips and other entertainment features. He praised the work of the local committee, of which Mr. C. C. Owens is chairman.

Electricity in Marine Service

Mr. H. A. Hornor, Philadelphia, Pa., a member of the committee on electricity in marine work, presided at the rest of the morning session. Mr. D. M. Mahood abstracted the paper prepared by Mr. C. S. McDowell and himself, on the subject of "Electric Heating in Marine Service." He made the interesting statement that the great new vessels, like the *Vaterland, Imperator, Aquitania, Oceanic* and others, have electric heating for the first and second cabins. Mr. W. S. Hadaway, New York, sent in a written discussion which was read by Mr. W. C. Smith. Messrs. A. E. Waller, Bronxville, N. Y.; Charles D. Knight, Schenectady, N. Y.; D. B. Rushmore, Schenectady, N. Y., and F. C. Caldwell, Columbus, Ohio, took part in discussion.

Mr. H. C. Ford then read his paper on "The Electrically Driven Gyroscope in Marine Work," adding that the stabilization of the aeroplane has now been accomplished by means of the gyroscope. In the discussion Mr. Rushmore praised Mr. Elmer E. Sperry, Brooklyn, N. Y., for his original and ingenious work in inventions relating to the gyroscope. Mr. Waller and the author also took part in the discussion.

Gyroscope in Marine Work

The laws of the gyroscope, as Mr. Ford pointed out, had been clearly laid down as far back as 1852 by Foucault. At the present time its most important uses have developed in marine work in steering torpedoes, in its use as a compass and in its applications for stabilizing and controlling the motion of ships. The gyrocompass is now being installed on all the battleships and submarines of the United States Navy where the magnetic compass could not possibly be used. On submarines, where the gyro compass is exceedingly important, a three-phase, 90-volt generator of special design is required to drive the heavy balance wheel at a velocity of about 8600 r.p.m. The characteristics of the generator allow the wheel to be thrown directly upon the line and brought up to full speed automatically in about thirty minutes without attention on the part of the operator and without excessive current. The servo-motor or follow-up system shields the gyro from all external forces and friction, rendering it sensible to a force couple of 0.00022 in.-lb.; operates the transmitter for sending out indications to any number of repeater compasses in distant parts of the ship, and operates the device correcting for speed, course and latitude of ship. So exact is the gyro-compass that the maximum error must not exceed 0.5 deg. in azimuth when swung for six days under conditions of rolling, pitching and yawing of an artificial ship. The stabilizing gyro will require one-tenth the space and weight of the equivalent best designed water pendulum.

Industrial Motor Session

The industrial power committee was in charge of the Tuesday evening session. Chairman R. R. Tschentscher, of Chicago, who presided, spoke of the extensive use of electricity in the iron and steel industry. Statistics from 170 plants show an aggregate of 400,000 kw in generator rating and 1,400,000 hp in motors now in operation in these steel-mill plants. The electrical plants of steel mills are usually very large and average outputs of 10,000,000 kw-hr. yearly.

Mr. R. H. McLain, Schenectady, N. Y., presented his paper on "Direct-Current Motors for Coal and Ore Bridges," which was discussed by Messrs. D. B. Rushmore, H. B. Lindsay, Worcester, Mass., and T. E. Tynes, Buffalo, N. Y.

From the chair President Mailloux announced the news of the death of Mrs. George Westinghouse, which occurred at her home at Lenox, Mass., Tuesday morning, June 23. At his suggestion Mr. C. W. Stone, of Schenectady, N. Y., a relative, was requested to convey to the family the sympathy and condolence of the Institute.

Mr. T. E. Tynes then read his paper on "Methods of Keeping Down Peaks on Power Purchased on a Peak Basis." The subject was discussed by Messrs. P. M. Lincoln, Pittsburgh, Pa.; J. Lester Woodbridge, Philadelphia, Pa.; J. R. Bibbins, Chicago, Ill., and R. H. McLain, Schenectady, N. Y. A written discussion was also presented by Mr. E. D. Dreyfus, Pittsburgh, Pa.

The paper on "Concatenated Induction Motors for Rolling-Mill Drive," by Mr. William Oschmann, was read, and was discussed briefly by Messrs. Tynes and A. E. Averrett, Schenectady, N. Y.

President Mailloux urged support of the International Electrical Congress to be held at San Francisco next year, and Mr. W. A. Phillis, Pittsburgh, Pa., gave a talk, illustrated with motion pictures, on the processes of making steel pipes and tubes.

Electrophysical Discussion Wednesday Morning

Three scientific papers were presented at Wednesday morning's session, over which Dr. J. B. Whitehead, of Baltimore, Md., chairman of the electrophysics committee, presided. Mr. F. W. Peek, Jr., of Schenectady, N. Y., abstracted his paper on "The Sphere Gap for High-Voltage Measurements," and Dr. Whitehead summarized the paper by Mr. W. S. Gorton and himself on "The Electric Strength of Air," and also in the absence of the authors the paper on "Sphere-Gap Discharge Voltages at High Frequencies," by Messrs. J. C. Clark and H. G. Ryan.

The three papers were discussed together. A written contribution by Mr. C. W. Chubb, of Pittsburgh, Pa.,

was read by Mr. P. M. Lincoln, Pittsburgh, and a written discussion by Mr. D. M. Mahood, New York, was read by Mr. A. E. Waller, Bronxville, N. Y. Others taking part in the discussion were Prof. F. C. Caldwell, of Ohio State University, Columbus, Ohio; Mr. C. L. Fortescue, Pittsburgh, Pa.; Prof. D. D. Ewing, of Purdue University, Lafayette, Ind.; Mr. E. E. F. Creighton, Schenectady, N. Y.; Mr. H. B. Dwight, Hamilton, Ont.; Mr. W. W. Lewis, Pittsfield, Mass.; Mr. E. D. Peck, Atlanta, Ga.; Mr. J. R. Craighead, Schenectady, N. Y., and Dr. M. G. Lloyd, Chicago.

Zero Resistance and Perpetual Current Flow?

At the close of the discussion Professor Whitehead described briefly some recent and apparently remarkable experiments made by Prof. Kamerlingh Onnes, of Leyden. A small short-circuited coil of lead wire was submerged in liquid helium and subjected to the action of a magnetic field. While the coil was thus maintained nearly at absolute zero temperature, resulting in reducing its electrical resistance to zero, a current of electricity was caused to flow in the coil by magnetic induction. The magnetizing influence was then removed, but the flow of electricity persisted, it was declared, and apparently might have gone on indefinitely, although the experiment was concluded at the end of four and one-half hours.

The remaining Thursday and Friday sessions of the Detroit convention will be reported in next week's issue of the *Electrical World*.

Convention Cruise of Michigan Section, N. E. L. A.

Another pleasant shipboard convention was added to the record of the Michigan Section of the National Electric Light Association on June 17-20. At 5 p. m. on the date first named a party of 120 ladies and gentlemen left Detroit on the steamer *City of Cleveland III*. The first session was held that evening on the boat, President H. C. Sterling, of Three Rivers, Mich., presiding.

In the morning (June 18) the party disembarked at Buffalo and proceeded to Niagara Falls on interurban electric cars. Several hours were spent at the Falls, some of the visitors inspecting the famous hydroelectric plants, some crossing to the Canadian side to the scene of the international negotiations. Late in the afternoon the travelers went to Youngstown, N. Y., via the Gorge route, embarking on the steamer *Rochester*. The second session was held during the evening on this boat.

After traversing Lake Ontario, Ogdensburg, N. Y., was reached at 8 a. m. on June 19. A stay of three hours was made in this port, during which time Mr. E. E. Hawkins, of the Ogdensburg Power & Light Company, entertained the party on an interurban-railway inspection tour. Turning westward, the boat made a stop at Alexandria Bay and then set her course for Toronto. The third session was held on board on the night of June 19. It was followed by a successful shipboard rejuvenation of the Jovian Order. Toronto was reached early on the morning of June 20. Here a special Pullman-equipment Canadian Pacific train was taken to Detroit, which was reached at 2.30 p. m. A short executive session was held on the train. The trip was thoroughly enjoyed by all who participated.

Public Utility Regulation

In his annual address President H. C. Sterling praised Secretary Herbert Silvester, of Detroit, for his work in preparing for the convention and boat trip. He remarked the increasing amount and complexity of the work of the N. E. L. A. and said that the geographic sections have an important function. Michigan takes satisfactory rank in the industry, but, unfortunately, is second only to Ohio in number of municipal plants. Mr. Sterling made a plea for good service and reasonable rates and accepted the principle of regulation.

Three good papers relating to important questions of policy were read. Mr. H. A. Fee, of Adrian, Mich., discussed "Reserves for Depreciation." He urged the extreme necessity of establishing an actual cash fund of from 3 to 6 per cent for depreciation. He gave journal and ledger forms, with entries showing the various transactions that occur in setting up and maintaining a reserve-for-depreciation fund.

Mr. Halford Erickson, member of the Railroad Commission of Wisconsin, read a comprehensive, clearly reasoned and valuable paper on "Regulation and Reasonable Returns," an abstract of which is presented on the following page.

Mr. James V. Oxtoby, of the Detroit bar and a vice-president of the Detroit Edison Company, gave the association the benefit of his professional opinion on "Contract and Franchise Rates as Affected by the Public Service Commission Laws." A number of court decisions were cited. Mr. Oxtoby concluded that all contracts entered into between a public utility and its customers are subject to cancellation or revision by a public service commission expressing the police power of the state. However, Mr. Oxtoby said, rates fixed by a franchise are binding as between the municipality and the public utility. Whether such rates are subject to change by legislative authority, where express power is conferred upon the municipality to fix rates, is open to question.

Mr. William J. Norton, of Chicago, gave an address on "Wild Schedules I Have Known." In a good-natured way he pointed out some mistakes of electric service companies in rate-making. Mr. Norton, who is a member and former secretary of the rate-research committee of the N. E. L. A., elucidated the basic considerations entering into the making of rates for the sale of electricity. He declared himself in favor of the demand system of charging and urged not uniform rates but a uniform method of making rates, based on cost.

Mr. H. G. Hall, of Mount Clemens, Mich., gave an illustrated paper descriptive of the electrically operated deep-wells now in service at Richmond, Mich. Mr. Hall said that the local electric-service company considers this class of business very desirable. In the discussion, Professor Bissell described briefly the new Hill-Tripp type of deep-well pump as adapted for electric drive.

Water-Power Transmission and Substation Construction

Prof. G. W. Bissell, M.E., dean of the engineering department of Michigan Agricultural College, East Lansing, presented his paper on "Hydroelectric Power in Michigan." The compilation consisted principally of tables and maps. The data presented showed that there are probably not less than 250,000 hp developed by water-power, while it is probable that a development of 400,000 hp will be witnessed in the State within the next ten years.

Automatic Substation

The Rowena Street substation of the Edison Illuminating Company of Detroit was the subject of an illustrated paper by Mr. James W. Bishop, superintendent of the operating department of the company named. This 500-kw substation, which is operated and started from another plant a mile distant, was described in the *Electrical World* of March 17, 1912, and June 28, 1913.

The paper by Mr. A. A. Meyer, of the Edison Illuminating Company, Detroit, on "Outdoor Substations" brought out some discussion. The author, with the aid of pictures, considered the development of outdoor high-tension switching apparatus which will permit the tapping off of small amounts of energy along high-voltage transmission lines. He listed many applications, some unusual—as a floating 32,000-volt substation used on a river in connection with dredging operations. A table of minimum economical sizes for various voltages, and approximate cost curves of stations with different equipment, were also given.

The discussion related principally to serving farmers and other customers in rural districts. Among those taking part were Messrs. H. C. Sterling, J. A. Cavanaugh of Benton Harbor, R. R. Thomson of Battle Creek, F. R. Mistersky of Detroit, H. A. Fee of Adrian, H. G. Hall of Mount Clemens, James W. Bishop of Detroit and the author of the paper.

Mr. Cavanaugh has 4 miles or 5 miles of single-wire grounded 2300-volt transmission line connected to his Benton Harbor system (see *Electrical World* of Sept. 20, 1913, page 595). Double grounds are employed, both iron pipe and copper cones buried in charcoal being used. The line has been in operation a year and a half and has given no particular trouble, although the telephone people look askance at it. However, such a line could be used only where the demand for power is small. The grounds do not carry more than 10 amp. The Benton Harbor company does not accept money from farmers or other customers for making extensions. The returns to the company are fairly satisfactory. On one farmers' line perhaps half the houses are equipped with some form of electric pumping apparatus. There is also considerable cooking by electricity. Cooking apparatus is sold to customers at cost. The usual rates apply to the farmers, 10 cents per kw-hr. being the maximum.

PRESIDENT-ELECT H. A. FEE

Mr. Charles B. Scott, of Chicago, manager of the bureau of safety of the Middle West Utilities Company, made an effective speech setting forth the importance of the "safety first" movement on both humane and economic grounds. He related some remarkable instances showing the reduction of accidents by systematic effort. The effort should be not so much to guard machinery as to guard the mind of the thoughtless workman. The electric-service industry is not in itself particularly hazardous; nearly all accidents are due to thoughtlessness.

Illumination Topics

Both men and women were interested in the illustrated lecture of Mr. M. Luckiesh, of Cleveland, Ohio, associate physicist of the Nela Research Laboratory, on "Fundamental Principles of Interior Illumination." The speaker showed that light is not only the master painter, but also—since it may be made to reveal varying effects—the master sculptor as well. Mr. Luckiesh gave an intimation of the enormous opportunity for service and beauty opening before the modern lighting specialist.

Mr. J. R. Colville, Cleveland, Ohio, of the engineering department of the National Lamp Works of the General Electric Company, presented in abstract his paper on "The New Mazda Lamp." He pointed out that the new nitrogen-filled tungsten lamps are essentially high-current lamps. The flood lighting of building façades was mentioned; also the promise that photographic work can be done with the new lamp with results about as good as with daylight. In these new lamps the blackening of the bulb is not so bad that the lamp may not be burned upside down on occasion. Mr. Colville said that in most cases it will pay plant managers to throw away inclosed arcs for street lighting and to use the new lighting units.

New Officers

Officers were elected as follows: President, Mr. H. A. Fee, Adrian; vice-president, Mr. Samuel A. Freshney, Grand Rapids; secretary and treasurer, Mr. Herbert Silvester, Detroit; executive committee, Messrs. A. C. Marshall, Detroit; H. C. Sterling, Three Rivers; R. R. Thomson, Battle Creek; A. D. Furlong, Saginaw, and Thomas Chandler, Sault Ste. Marie. Past-president R. W. Hemphill, Jr., of Ann Arbor, was chairman of the nominating committee.

Mr. H. A. Fee, the new president of the Michigan Section of the National Electric Light Association, is president and general manager of the Citizens' Light & Power Company of Adrian, Mich. This company supplies both electric service and steam heating. It was organized in 1903, succeeding the Electric Light & Power Company, which in turn succeeded J. H. Fee & Son. The plant was first established by Mr. W. A. Foote, and was bought in 1885 by Mr. J. H. Fee, father of Mr. H. A. Fee. In 1903 it was entirely rehabilitated. The elder Mr. Fee died in December, 1913, and Mr. H. A. Fee became president, having been general manager for the preceding ten years.

Halford Erickson on Reasonable Return

A valuable and closely reasoned contribution to the literature of public utility regulation was made by Mr. Halford Erickson, member of the Railroad Commission of Wisconsin, before the Michigan Section of the National Electric Light Association on June 17. Mr. Erickson's subject was "Regulation and Reasonable Returns." The speaker pointed out that regulation was first established for the protection of the public. To-day protection is provided for the utility as well as for its customers. Considering the reasonable compensation to be given for the service rendered by the utilities, Mr. Erickson said that this compensation is usually taken to cover interest and profit. In fixing this amount many different views are encountered. Some contend that no more should be allowed than the rate at which the municipality could borrow the necessary capital. On the other hand, it has been urged that no restriction whatever should be placed upon these returns. The reasonable or normal rate

of return is undoubtedly found somewhere between these two extremes.

Reasonable Return Made Up of Interest and Profit

Interest and profits are made up of interest on the capital used, insurance against risks and profits for the enterpriser. However, the insurance against risks is seldom treated as a separate factor but rather as a part of the other two. Those who furnish the capital receive interest as a compensation for the service rendered by the capital. The enterprisers, who assume the risk and responsibilities for the management, receive profits as their share for the services they perform. For both of these factors the rate of these returns is higher in proportion to the risk of the undertaking.

Function of the Enterpriser

In the present day business is largely carried on by enterprisers on borrowed capital on which interest is paid. This condition has led to the separation of the functions of the capitalist and the enterpriser or employer and to a more complete analysis of the compensation that each of these factors receives. Profits have their source in the business ability, skill and foresight of the enterprisers, or in their management. The enterpriser is a sort of economic buffer who bears the shock and often much of the loss in case of failure and who also reaps the credit and much of the profits in case of success. Successfully to exercise the functions of an enterpriser requires a high order of ability. Such a man must have organizing capacity of a high order. He must be a good judge of men and have tact in dealing with them. He must have the command of financial resources and the ability to plan and execute broad commercial and industrial policies. He should also have the technical knowledge that is required to adopt the best methods, outline the most economical processes and to pass properly on materials and products.

The wages of management must be high enough to encourage men of the necessary ability and skill to enter the field. Risks are always present and must be assumed by every enterpriser. In the long run the compensation for risks will not fall below the point at which a sufficient number of enterprisers are found who are willing to assume it.

Public Utility Securities Favorably Regarded

In Mr. Erickson's opinion, public utilities should be well regarded by the investor. It is now becoming generally understood that one utility can serve a community better and at lower rates than two or more utilities. Their business goes on in good times and bad and is not often seriously affected by general business depressions. As a rule the utilities earn good returns on a fair valuation. If the securities issued do not exceed this value, then they should be safe. But public utility securities are not wholly free from risks or all other objectionable conditions. Still, giving all factors proper weight, it will mostly be found that public utilities should be well regarded by investors and that the capital needed should be obtained on favorable terms.

The Cost of Securing Capital

Mr. Erickson gave at considerable length the result of an investigation he has made of a large number of bond and stock issues of public utility companies. Ten representative first-mortgage bond issues covering electric service and street-railway plants, brought out in 1913, bearing 5 per cent interest, were placed on the market at prices yielding the investor from 5 to 6 per cent. The average cost to the companies for bond discounts and selling expenses was 6.2 per cent. During the same period ten representative second-mortgage bond issues, covering the same class of properties at the same interest rate, were offered at prices to net investors from 5 to 6.2 per cent. In this case the cost to the companies of this financing was about 6.4 per cent.

Twelve note issues were offered to the public on an average 6.2 per cent income basis. Here the cost of financing was about 9.4 per cent per annum. Five preferred-stock issues were sold on a basis to yield the investor about 7.3 per cent. The cost to the companies was of course much greater than the price to the public. Facts were given by the speaker to show that within the last ten years it has been necessary to market railroad and industrial issues in this country at a rate to produce a greater income return than formerly.

An interesting illustration was presented by Mr. Erickson. He assumed a public utility with plant and business worth about $1,000,000 represented by $800,000 in bonds and $200,000 in stocks. If such an enterprise has net earnings above operating expenses, depreciation and taxes of $75,000 a year, or 7.5 per cent on the value, it would probably be able to sell its bonds on about a 5.5 per cent basis and its stock on something like a 6 per cent basis, provided the conditions are such that these earnings are likely to continue, and provided further that the stock from time to time would receive something in the way of extra dividends or rights. "It appears from these facts," said Mr. Erickson, "that in the public utility field, even under favorable conditions, it is not safe to assume that interest and profits will require less than 7.5 per cent on a fair value of the plant and its business."

This return is considerably higher than the rate at which municipalities can borrow money when the loan is supported by all the taxable property of the city, as well as by its full taxing power. "It would almost seem idle to argue that public utilities should be allowed no greater return for interest and profit than the rate at which the city could borrow the capital under its full borrowing and taxing powers."

Many Rates Are Too Low

Mr. Erickson went on to say that many rates made a few years ago, not only by commissions but by the utilities themselves, are now too low. The situation that has arisen in this way is very embarrassing. Interest rates have increased during the past decade, and the capital itself has been hard to get even when extra inducements were offered. Prices of leading commodities are now about 50 per cent higher than they were eighteen years ago. Just now we seem to be passing through a period of readjustment. While predictions in this respect are futile, many good judges would perhaps not be surprised if the movement now under way had not as yet completed its course.

It is evident that increases in the cost of furnishing the service, unless accompanied by increases in the earnings, mean lower returns for the enterpriser, and perhaps also for the investor. "If this condition is not remedied and the plant is compelled to go on and furnish service for less than paying rates, the result will be that new capital will not enter the field, that needed extensions to the plant will not be made, and that adequate service will not be furnished. The public will, in fact, fail to obtain the service it needs and upon which it depends. A situation like this is neither fair nor in line with public policy. It should be remedied, if necessary, by providing more earnings through higher rates. In fact, it is as much in line with public interest to raise rates that yield less than reasonable returns as to lower rates that yield more."

$100 Bonds Might Be Sold to Small Investors

The speaker concluded his important paper by recommending that the smaller companies issue bonds in denominations of $100 instead of $1,000 and sell them to small investors, especially the customers of the plant. This plan would enable the small investors to get what should be considered a sound investment at better than savings-bank interest. It would also enable the utilities to place their bonds where they would do the most good, and closer relations between the utilities and the public would be established.

As it stands to-day, the doctrine of reasonable return is that the reasonableness of such return is not measured by the bare rate of municipal bond interest but rather by the amounts for which the capital needed and the enterpriser can be had.

Illinois Electrical Contractors' Association Meeting

Liability insurance was the topic of main interest at the semi-annual meeting of the Electrical Contractors' Association of the State of Illinois at Danville, June 19 and 20. Data showing really remarkable savings, presented by Mr. E. J. Burns, assistant secretary, formed the basis of the discussion.

In the absence of Mr. Ernest Freeman, president of the National Electrical Contractors' Association, Mr. George W. Hill, special representative of the national body, spoke at the morning session on the benefits derived from co-operation the past ten years. It is estimated that during that period electrical contractors in general have improved their condition by approximately 100 per cent. Men who now are the influential contractors were at that time mostly new at the business, and many scarcely realize the strides that they have made.

Salesmen Speak at Open Session

Mr. Charles Brown, of the American Electrical Supply Company, urged the contractors to look more closely into the qualifications of prospective members. Business integrity, credit standing and the possession of a well-established place of business should be among the qualifications admitting a man to the association. Rules should be made for the expulsion of members for nonpayment of debt. Among the other salesmen who spoke were Messrs. W. T. Clawsen, Edison Storage Battery Company; H. Larson, Inland Electric Company; H. J. Russell, George C. Richards Company; G. H. Lounsberry, Western Electric Company; C. H. Method, Manhattan Electrical Supply Company; W. C. Reardon, I. A. Bennett Company; P. F. Lyons, India Rubber Company; P. F. Hensel, S. H. Couch Company; E. R. Hunt, General Electric Company; Edward Kerns, Monarch Electric Company; A. T. Ward, Phoenix Glass Company; E. W. Joseph, Electric Appliance Company; Thomas Endsley, Diamond Electric Company; J. W. Gaskins, Holophane Company, and A. W. Hillis, Western Electric Company.

Marron Charges Lack of Co-operation

At the close of Monday morning's program, the only open session, Mr. J. T. Marron, Rock Island, said that his organization had recently figured on $126,000 worth of business, and of this amount $36,400 had been lost on account of prospective customers undertaking the work themselves. This lost business, Mr. Marron said, would have gone to some contractor had manufacturers and jobbers refrained from competitive bidding. Electrical construction carried on by the average factory electrician or other person outside the electrical construction business seldom gives satisfaction and manufacturers who sell their material to be installed by unauthorized persons are inviting trouble, as failures are almost invariably attributed to the particular make of apparatus and not to faulty construction.

The plea is often made, said Mr. Marron, by the prospective customer that he can do electrical construction work cheaper than the electrical contractor. In order to answer this argument the contractor should endeavor to hire this man, who can without experience do successfully what the contractor had been learning to do all his life, and do it cheaper.

New Plan of Liability Insurance Saves

Since the last meeting of the Illinois association Mr. E. J. Burns, assistant secretary, has been investigating the subject of liability insurance, and he has found contractors paying premiums ranging from $1.50 to $2 for each $100 of payroll. In fact, the rates charged by all conference companies are $1.44 for employees' insurance and $0.25 for the public, making a total rate of $1.69 for each $100 of payroll.

Following his investigations, Mr. Burns inaugurated a plan under which he, as an officer of the association, handles the liability insurance of all members, transferring the business as a unit to one of the country's largest risk companies. Under this plan Illinois contractors who are members of the association are enjoying a rate of $1 for each $100 of payroll, this premium covering insurance for both the employees and the public.

PRESIDENT-ELECT W. J. BALL

The average saving of members now carrying insurance through the association is $70.36 a year. With the smaller contractors the saving amounts to about $25, and the largest saving of any one firm is approximately $500. As a conservative estimate Mr. Burns says that with the plan in full operation a saving of $20,000 a year will be effected for contractors in the State.

Routine Business

At the final session of the convention Saturday morning reports of the various committees were heard and it was suggested that the committee on state education, of which Mr. F. L. Decker, Chicago, is chairman, be dismissed. After some discussion the suggestion was voted down, for, although the national body has taken up the question of bookkeeping, there are still other educational features upon which the committee may profitably spend its time.

A discussion regarding the segregation of contracts

showed that the general opinion among electrical contractors is in favor of the practice of refusing to combine the estimates with those submitted by the general contractor. Most of the electrical contractors believe that electrical construction work is of sufficient importance to justify separate bids.

Election of Officers

The election of officers for the ensuing year resulted as follows: President, Mr. W. J. Ball, Moline (re-elected); vice-president, Mr. J. T. Marron, Rock Island; secretary and treasurer, Mr. E. J. Burns, Rock Island; board of directors, Messrs. Edward C. Pendergast, Rockford; L. E. Crawley, Peoria, and Guy Carlton, Bloomington. The national directors are Messrs. J. T. Marron, Rock Island, and William McGuineas and F. L. Decker, Chicago.

Mr. Burns, the secretary and treasurer, will act as the association's special representative in all matters. Mr. Burns, who is also secretary of the new Iowa association, will probably present many important and original data at the coming national convention on the saving to be gained by his plan of liability insurance.

Empire State Gas and Electric Association

At the midyear meeting of the Empire State Gas and Electric Association held at the Fort William Henry Hotel, Lake George, N. Y., June 19, about thirty companies were represented. The morning session was devoted almost entirely to the discussion of advertising, with particular reference to the use of space in newspapers. A number of interesting methods were brought out and there was much constructive and valuable criticism.

In a brief paper, Mr. MacSweeney, of the Rochester Railway & Light Company, described the advertising done by his company through newspapers. A number of instances were also cited where members had been able to trace the sale of apparatus directly to their newspaper advertising, and Mr. Robert E. Livingston, of the Consolidated Gas Company, presented some interesting figures in this connection.

After luncheon, which was served in the hotel, the meeting reconvened and a motion was made to appoint a committee of commercial men to devise ways and means of circulating among the members information relating to different methods of advertising.

The afternoon session was devoted to the question of the supply and renewal of incandescent electric lamps or the sale of lamps or other apparatus at less than cost. Considerable difference of opinion developed, and it was decided to postpone further discussion of the subject until some future meeting to be devoted to this topic.

Milwaukee's Street-Lighting Survey

Mr. Francis A. Vaughn, of Milwaukee, was on June 23 appointed to the newly created position of engineer of street-lighting survey for the city of Milwaukee. The local ordinance ordering the survey requires that a study be made of present lighting systems to determine the one best suited for the illumination of Milwaukee's boulevards, streets, parks and public buildings. The report of the survey engineer is to be made to the Commissioner of Public Works and to the Common Council. The engineer in charge is appointed for one year.

Society of Automobile Engineers

At the convention of the Society of Automobile Engineers held at Cape May, N. J., June 23 to 26, several papers on electric-vehicle topics were presented. The report of the electrical equipment division, of which Mr. A. L. Riker is chairman, recommended that all insulating material for lighting fittings be selected to withstand 300 deg. Fahr. continuously for thirty minutes. The single-wire system with grounded return was also recommended for car-lighting practice.

Starting, Lighting and Ignition Devices

The requirements which must be filled by automobile starting, lighting and ignition devices were discussed in Mr. Albion D. Libby's paper on "Starting, Lighting and Ignition Devices." Two-unit, 12-volt starting and lighting systems were recommended, with a gear ratio which would permit of proper carburetion with the least expenditure of energy. Single-wire grounded lighting systems were denounced and fuses

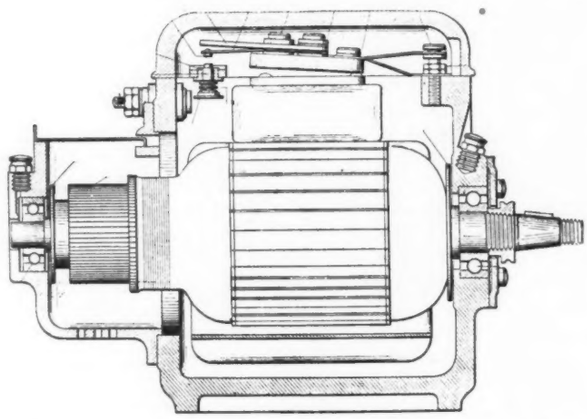


FIG. 1—GENERATOR ARRANGED TO PREVENT LARGE CURRENT FLOW

were recommended in all lamp and motor circuits. The author advised using an ammeter on the dashboard to show when conditions are abnormal. A starting-motor clutch, a combined generator and regulator, a dashboard ammeter, a new ignition system and several wiring schemes were described.

Six-volt starting equipment is undesirable because it requires circuits of unusually liberal cross-section to prevent losses, and because bad contacts at brush surfaces or switch contacts cut down the potential available at the motor. Eighteen-volt or 24-volt apparatus has the disadvantage of requiring more complicated wiring and control and in addition necessitates parallel charging of batteries, which is objectionable. The 12-volt system, declared the author, is a satisfactory compromise which permits using 6-volt standard lamps in series, simple control and wiring, and series charging of batteries.

Attention was called to the fact that a starting motor should be series-wound and a generator shunt-wound, and that these characteristics can be obtained most economically with a two-unit set. A starting-motor clutch was described consisting of eight pawls engaging with a ratchet wheel, the pawls being thrown out of engagement by centrifugal force when the engine picks up the load. Cranking speeds of 100 r.p.m. to 135 r.p.m. were recommended for four-cylinder engines.

A compound-wound generator was described which depends for its voltage and current-discharge regulation on the automatic insertion of resistance in the shunt-field circuit. This operation is performed by a

magnetic keeper being attracted by the polar projections when the field flux rises too high. The differential action of the series winding, together with the reduction in field flux caused by the insertion of resistance, prevents excessive current flow at high speeds.

It was very strongly urged that fuses be inserted in the motor leads. For a 12-volt starting-motor fuse the starting fuse should be capable of carrying 300 amp momentarily and 175 amp for five minutes, but should melt in fifteen seconds with 225 amp flowing.

A new type of dashboard ammeter was described which allows the lines of force to pass through the entire area of the movable element, thereby increasing the torque and damping effect. Two recent productions in high-tension magneto apparatus were also described which permit of 75 deg. or 80 deg. advance in sparking time without affecting the strength of the spark. No auxiliary ignition system is needed with either type described when starting the engine, as a spark can be obtained by short-circuiting the magneto suddenly.

Taxation of Motor Vehicles

The paper entitled "An Engineering Basis for Taxation of Motor Vehicles," by Messrs. C. O. Edgerton and S. I. Fekete, contained a complete and exhaustive analysis of the destruction to roads caused by motor vehicles, with suggestions for a new system of vehicle taxation based on this factor instead of the horse-power of the vehicle. The amount of damage which a vehicle can inflict on a road is dependent on the speed of the car, the unit pressure at the tire contacts, the character of the tires and road, and the diameter of the wheels.

The conclusion drawn was that vehicles should be taxed in proportion to the damage inflicted upon roads and to the number of hours of use per day. Motor-driven omnibuses can be assumed to operate about fifteen hours per day, commercial trucks about 8.25 hours and pleasure cars 4.75 hours. Thus, if the basic rate is set on pleasure vehicles, the rates applying to trucks and omnibuses should be about 1.75 and 3.125 times the basic rate. It was suggested that lower speed limits be prescribed for vehicles exerting excessive unit pressure at the tire contacts. To facilitate assessing a wheel tax on the road-destruction basis, it was suggested that a formula of the general nature shown herewith be employed.

$$\text{Total tax} = \frac{W\alpha}{r} V_m \times K \times \text{tax rate per minute},$$

where W represents total weight of car, α is the coefficient of rolling friction determined by experiment, r is one-half the tire diameter, V_m is the legal speed limit in miles per hour, and K is a factor proportional to the average number of hours' use per day.

Electric Transmission for Automobiles

The operating characteristics of the Entz electric transmission for automobiles were compared with those of mechanical and generator-motor transmissions in Mr. Justus B. Entz's paper entitled "Electric Transmissions for Motor Cars." The Entz system, which was fully described and illustrated on page 281 of the *Electrical World* of Jan. 31, 1914, consists of two dynamos the armatures of which are mounted on a common shaft driving the rear axle. The field frame of one dynamo is attached to and revolves with the gasoline-engine shaft, while the field yoke of the other unit is rigidly attached to the chassis. The first dynamo acts as a drag-clutch, generating energy which drives the second unit as a booster motor at intermediate speeds. At full speed the brushes of the drag-clutch generator are short-circuited and the booster motor operated as a generator for charging batteries, lighting lamps, etc. The accompanying curves show the speed, tractive effort and efficiency characteristics obtained with this system and with mechanical and generator-motor transmissions. With the electric transmission the gasoline engine can be operated continuously at its most economical speed. The efficiency of transmission at intermediate speeds with the Entz system is the product of the efficiencies of the two units composing that set. At

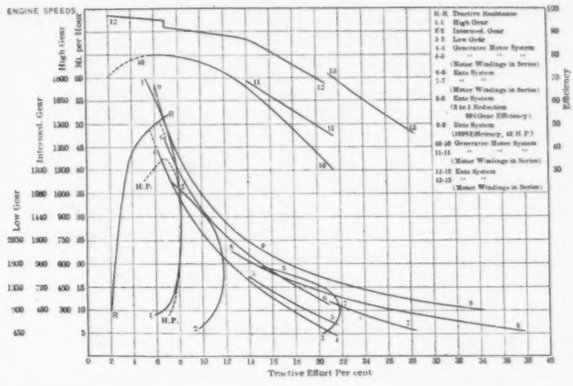


FIG. 2—CURVES SHOWING SPEED, TRACTIVE EFFORT AND EFFICIENCY CHARACTERISTICS

full speed the efficiency of transmission is the efficiency of the generator. To increase the torque transmitted by the Entz system it is not necessary to increase the current, as this result is obtained by allowing the generator to slip more and by utilizing the energy produced thereby to operate the booster motor. The amount of current taken by the booster motor is regulated by its field excitation.

The New York Edison Savings and Loan Association

At the annual convention of the New York State League of Savings and Loan Associations, held at the Hotel Statler, Buffalo, N. Y., June 11 and 12, Mr. E. E. Bondy read a paper telling about the New York Edison Savings and Loan Association. The association was incorporated in May, 1912, principally to provide a means of home owning and a form of saving through instalments. At present there are 1542 members, and loans varying from $200 to $7,400 and totaling $103,010 have been made. The association is conducted on the serial plan, a new series of instalment shares being opened each month. These shares, which have a value of $200 at maturity, are paid for at the rate of 25 cents a week or $1 a month. Thus a payment of $138 yields $200. The payments may be automatic, that is, deducted from the weekly wage. Mortgage loans and note loans are made. The appraisal committee and the company's attorneys are at the service of members free of charge.

Work on Conners Creek Plant, Detroit

Steady progress is being made on the Conners Creek generating plant of the Detroit Edison Company, which has been under construction for several months. This large station is situated on Lake St. Clair on the eastern outskirts of Detroit. The big Delray generating plant of the company is on the western side of the city, so that a good balance for transmission and distribution is effected. The character of the soil at the Conners Creek site is such that it was necessary to drive 9900 piles for the half of the ultimate station for which the foundations are in. These piles support a mat of rein-

forced concrete, on which the footings for the building and machinery will rest.

Ultimately this station may have a rating of 150,000 kw, the present plan being to install six 25,000-kva turbo-generators. The initial installation, however, will consist of 50,000 kva in two 25,000-kva units. About half of the steel framework for the initial installation is now in position, and it is expected that one of the new units will be in operation early in the winter of the present year and that the other will be turning over before the spring of 1915. Mr. Alexander Dow, the president of the Detroit Edison Company, said recently, in answer to a question from a representative of the *Electrical World*, that electric-service conditions in the City of the Straits are in quite a satisfactory condition. The rate of increase is not quite so large just at present as in previous years, but it is still good. The steadily growing load of the company makes the new plant a necessity.

"White Way" Lighting for Worcester, Mass.

On June 17, the anniversary of the Battle of Bunker Hill, more than 100,000 persons witnessed the inauguration of a new system of "white way" lighting at Worcester, Mass. The installation comprises nearly 500 6.6-amp General Electric ornamental luminous-arc lamps, placed at distances of 80 ft. to 125 ft. and mounted 14.5 ft. above the sidewalk, throughout the business district of the city. A feature of the celebration was a parade of seven divisions, the climax being an electrically illuminated display of service automobiles by the Worcester Electric Light Company, with a float occupied by young women employees grouped about a "Queen of Light," who carried a 750-watt nitrogen-filled lamp on a golden wand. Attached to the float were numerous inscriptions emphasizing the desirability of electric service. The Worcester Rotary Club and other organizations also made excellent use of electric lighting from storage batteries in the displays carried in the procession.

Electrical Construction in Minneapolis and Southern Minnesota

Permanent improvements and extensions for 1914 to the Minnesota properties of the Consumers' Power Company of that State, all of the stock of which is owned by Northern States Power Company, are already in progress under the engineering supervision of H. M. Byllesby & Company. Most of the materials and machinery have been ordered, and the Coon Rapids hydroelectric development on the Mississippi River near Minneapolis is being completed. The first 2100-hp unit of this new water-power, which will add, ultimately, 10,500 hp to meet the rapidly increasing electrical demands of Minneapolis, will, it is expected, be in operation Aug. 1.

Construction work authorized for the Minneapolis division within the city of Minneapolis includes enlargements to substations, additions to the 13,000-volt underground feeder systems and extensions to the distributing lines in various parts of the city. These improvements will enable the company to serve a large amount of new business and to distribute the output from Coon Rapids.

Another important construction feature will be a transmission line 33 miles long from St. Paul south to a point 3 miles east of Northfield, where it will connect with the hydroelectric network of the Faribault and Mankato divisions comprising 100 miles of transmission lines. This line will be of Byllesby standard construction designed to carry 60,000 volts pressure. It will roughly parallel the Chicago, Milwaukee & St. Paul Railway and proceed via Farmington, Westcott, Rosemont and Castle Rock, opening a number of additional rural markets for service. Connection of the distributing systems of the Twin Cities and the Faribault and Mankato divisions will insure further reliability and quality of service and will give to a considerable section of southern Minnesota an interurban electric light and power service matched by few other communities. Five water-power plants, with an aggregate rating of 36,500 hp, and six steam stations, with 29,500 hp, or a total of 66,000 hp, will be connected to the system. During the present year a number of short extensions will probably be made to serve additional cities and towns. Mr. William T. Walker will be resident superintendent of construction at Minneapolis. Mr. Lincoln Nissley will be superintendent of construction on the transmission lines.

Memphis Electrical Show

Under the auspices of the local Jovian League a co-operative electrical exposition was held at Memphis, Tenn., during the week of June 15 to 20. A feature of the show was the plan by which the contractors, dealers and manufacturers taking part pooled their exhibits, permitting the displays to be classified into domestic and industrial departments. Household conveniences, for example, were shown in one booth, heating appliances in another booth, and kitchen devices in a third. Particular attention was attracted by the lighting and decorative effects, popular interest centering upon a huge electric fountain designed by Mr. C. K. Chapin, chairman of the committee on decorations.

EXHIBIT BOOTH IN MEMPHIS CO-OPERATIVE ELECTRICAL EXPOSITION

Mr. W. H. Burroughs was general chairman of the show, and Mr. F. F. Sparks was director. The following acted as chairmen of committees: Mr. H. G. Street, finance; Mr. C. K. Chapin, decorations; Mr. W. C. Tupper, publicity; Mr. C. J. Watson, exhibits; Mr. J. F. Ramier, entertainments; Mr. Burns Stewart, lighting and signs, and Mr. W. R. Herstein, arrangements. The officers of the Jovian League of Memphis are Mr. W. R. Herstein, president; Messrs L. G. Van Ness, H. G. Street and C. K. Steig, vice-presidents, and Mr. W. C. Tupper, secretary and treasurer.

Public Service Commission News

Illinois Commission

The State Public Utilities Commission of Illinois, of which Mr. James E. Quan is chairman and Mr. Charles N. Hebner of Springfield, Ill., is secretary, has issued rules of practice and procedure, with forms, governing matters before the commission. Among other things it is provided that the commission, or any commissioner or officer of the commission designated by the commission, shall have power to hold investigations. It is provided that the technical rules of evidence need not be followed in such hearings and that no informality in any proceeding shall invalidate any order, decision or regulation made, approved or confirmed by the commission. All hearings shall be open to the public.

A dispute over service and cost of street lighting in the city of Jerseyville, Ill., has arisen between the city authorities and the Central Illinois Public Service Company. As a result the Council passed a resolution ordering all street lamps shut off and disclaiming all liability for payment for any lighting after the last day of May, 1914. Mayor A. C. Robb is authorized to employ attorneys to assist City Attorney R. A. Nutt in any legal proceedings against the company in the courts or before the Public Utilities Commission.

Indiana Commission

The city officials of Indianapolis, Ind., claim under an amendment to an act of 1904 the right to contract with public utilities regarding rates for both city and individual service. Under this amendment they question the power of the Public Service Commission to establish rates. The members of the commission, however, believe that the law is invalid, the amendment having been passed after the act itself had been repealed. The commission has practically completed its inventory of the property of the Indianapolis Light & Heat Company and the Merchants' Heat & Light Company. It is thought that the valuation will be very nearly $10,000,000.

Maryland Commission

The Public Service Commission of Maryland refused permission to the United Railways & Electric Company to issue $1,000,000 two-year 5 per cent trust notes convertible into common stock at 33 1/3, or a total of $1,500,000 par value. This decision is expected to affect every corporation in the State, for the commission has placed itself in a position of decided opposition to the watering of stocks. No matter what decisions may have been rendered in the past, this one now has precedence. The company presented a modified plan whereby the notes were to be converted at par, which is $50 a share. The commission approved of this plan.

Ohio Commission

A committee of the Ohio Electric Light Association met last week with representatives of the state public utilities commission, for the purpose of arranging a standard form of appraisement of electric-light companies to be made in accordance with the commission's orders. The committee representing the lighting companies consisted of Messrs. F. B. Lasser, Youngstown; L. K. Funkhouser, Dayton; F. F. Wickham, Cincinnati; F. W. Drager, Canton, and J. H. Scobell, Cleveland.

The electric-lighting companies operating in Ohio have been appraised for purposes of taxation at $40,291,830. About 150 companies are included in the valuation, that of the Allinger Milling Company, of Quincy, being the smallest ($200) and the Cleveland Electric Illuminating Company, with an assessment of $17,792,560, being the largest. The Cleveland company's assessment showed the largest increase, the advance being $1,276,000. The increase is accounted for by extensions and betterments resulting in increased earnings which are believed to justify the increase. Among the increases announced are the following: Youngstown Consolidated Gas & Electric Company, from $3,373,880 to $3,967,890; Sheriff Street Market & Storage Company, Cleveland, from $1,041,650 to $1,049,260; Springfield Light, Heat & Power Company, from $1,205,800 to $1,209,510; Trumbull Public Service Company, Warren, from $888,780 to $908,830; Ohio Light & Power Company, serving twelve central Ohio cities, from $1,455,150 to $1,662,110; Sandusky Gas & Electric Company, from $838,140 to $859,180; People's Light & Power Company, from $16,770 to $20,000; Xenia Gas & Electric Company, from $144,970 to $155,120; Canton Electric Company, from $1,760,080 to $2,116,170; Dayton Power & Light Company, from $3,310,890 to $3,876,790; Massillon Electric & Gas Company, from $275,180 to $318,700; County Electric Company, Coshocton, from $397,550 to $416,650; Wilmington Water & Light Co., from $140,000 to $150,000.

California Commission

The Indian Valley Electric Light & Power Company has filed an application with the Railroad Commission of California, asking the commission to modify an order made in September, 1912, which authorized the issue of $81,535 of 6 per cent bonds. The company has not issued any of the bonds authorized under the order and wishes now to enter into an agreement with the Great Western Power Company to take power at the Big Meadow Dam, which is 13 miles from the main station of the applicant.

The Railroad Commission has rendered a decision in which it grants authority to the Big Four Electric Railway to issue 392,058 shares of its capital stock at the par value of $1 a share. The sale of this stock is restricted so that no commissions are allowed until $100,000 in cash is realized and deposited to the credit of the company, and thereafter no commissions in excess of 20 per cent shall be allowed stock salesmen. The commission also directs the board of directors of the company to recover or reimburse the treasury in the sum of $1,798, owed to the company by Frank Avery, promoter and chief stock salesman of the company and proprietor of the Avery Mill & Lumber Company.

Wisconsin Commission

The commission has authorized an increase in the rates of the Browntown municipal light plant. An investigation disclosed the fact that the cost of operation is considerably in excess of the revenues received, owing very largely to the fact that but a small proportion of the possible number of consumers are taking service from the plant. In this connection the commission was not inclined to prescribe rates which would make the plant self-supporting with its present number of consumers, and attention was called to the fact that the public in going into the venture was fully aware of the conditions involved and could not, therefore, expect the few consumers to stand the entire cost of operation. The present rate schedule consists of a primary rate of 15 cents per kw-hr. for the first 10 kw-hr. used per month, a secondary rate of 10 cents for the next 10 kw-hr. and an excess rate of 8 cents per kw-hr. The commission prescribed a primary rate of 15 cents per kw-hr. for the first 50 kw-hr. used per month and an excess rate of 12 cents for all energy consumed in excess of 50 kw-hr. per month. The minimum bill was increased from 50 cents to 75 cents per month.

Current News Notes

THE AMERICAN PETROLEUM SOCIETY FORMED.—The American Petroleum Society has been formed to consider subjects relating to the science and technology of petroleum and its products for the benefit of the consumer as well as the producer. The secretary is Dr. I. C. Allen, 506 United States Custom House, San Francisco, Cal.

* * *

COMMUTATION.—In the article on commutation by Prof. Alfred Still, the first section of which appeared in the *Electrical World* of June 20, Figs. 4 and 5, which are somewhat similar in general appearance, became transposed on page 1444. The illustration containing references to the neutral zone and the commutating zone is the one designated as Fig. 5 in the text.

* * *

ELECTRIC VEHICLE TOURING.—The New York Electric Vehicle Association has just issued a new booklet, "Electric Touring," which will be found useful not only to present users of electric vehicles but also to manufacturers and dealers in convincing prospective purchasers of the extensive facilities now available for charging electric vehicles and of their consequent adaptability for suburban runs. Copies of the booklet may be obtained from the treasurer of the association, Mr. Harvey Robinson, Irving Place and Fifteenth Street, New York City.

* * *

OVERHANGING SIGNS MUST GO.—At the instance of Mayor Harrison of Chicago, Mr. Joseph O. Kostner, deputy commissioner of public works, has issued an order notifying property owners along Clark Street that they must remove all overhead signs. No objection is made, however, to signs which lie flat against the building. Mr. Victor H. Tousley, chief electrical inspector, states that this order affects 132 signs on Clark Street in the restricted district between Jackson Boulevard and the river. A similar order, which will necessitate the removal of about seventy-five signs, is soon expected for Dearborn Street.

* * *

KILLING INSECTS WITH ELECTRICITY.—Electrical apparatus has been invented by M. Friggori, province of Santa Fé, Argentina, for killing insects which are harmful to the growth of trees and grain. A metallic net supported on a two-wheel vehicle is suspended over the ground where the insects are to be killed, and 6000-volt energy is allowed to discharge from it to the ground. The net and the earth are energized from one terminal of a step-up transformer on the vehicle, the other terminal being grounded. By brushing trees with a metallic broom energized from the same apparatus it is claimed that any insects harboring thereon can be killed.

* * *

SOCIETY MEETINGS

JOVIANS AT SAGINAW, MICH.—A branch of the Jovian Order has been established at Saginaw, Mich., with a membership of thirty. Mr. W. J. Trott, statesman for Grand Rapids, and Mr. Richard L. Kimball, statesman for Saginaw, organized the new section.

* * *

TELEPHONE PIONEERS TO MEET.—The fourth annual meeting of the Telephone Pioneers of America will be held at Richmond, Va., Oct. 29 and 30. The headquarters will be at the Jefferson Hotel. Mr. H. W. Pope, 15 Dey Street, New York, is secretary of the association.

MONTREAL ELECTRICAL SOCIETY.—The following officers have been elected for the current year by the Montreal Electrical Society: President, Mr. J. N. Mochon; vice-president, Mr. L. E. Hamilton; secretary, Mr. J. C. Bray; treasurer, Mr. E. L. Brewer. Board of directors—contracting, Mr. W. H. Tees; commercial Mr. T. R. Campbell; manufacturing, Mr. R. McIllwraith, and traction, Mr. P. T. Davies.

* * *

LOS ANGELES SECTION, E. V. A.—The Los Angeles (Cal.) Section of the Electric Vehicle Association of America has been organized with a membership of thirty-one. Mr. J. H. Pieper is president, Mr. H. W. Harrison vice-president and Mr. J. F. Rogan secretary. The executive committee consists of Messrs. G. B. McLean, A. T. Smith, J. O. Case, H. J. Kister, E. C. Anthony, I. R. Solomon, Charles Carter and V. S. Beardsley.

* * *

WASHINGTON SECTION, E. V. A.—At the June 25 meeting of the Washington (D. C.) Section of the Electric Vehicle Association Mr. Walter Metz, of the Government Printing Office, was scheduled to speak on the subject of "Electric Truck Operation." To Major Richard Sylvester, of the Washington police, was assigned the topic of traffic regulations in the capital. Messrs. J. J. Bartram, C. R. Erkman, A. L. Dickson, Charles M. Marsh and E. S. Marlow composed the committee which arranged the meeting.

* * *

ASSOCIATION OF MUNICIPAL ELECTRICIANS.—The nineteenth annual convention of the International Association of Municipal Electricians will be held at Atlantic City, N. J., Sept. 15 to 18, with headquarters at the Hotel Isleworth. In connection with the convention an exhibit of fire-alarm and police-signal apparatus will be made. Mr. John W. Kelly, Jr., Camden, N. J., is president of the association, and Dr. C. P. Steinmetz, Schenectady, N. Y., is first vice-president. The secretary is Mr. Clarence R. George, Houston, Tex.

* * *

REJUVENATION ON LAKE ONTARIO.—On the night of June 19, during the convention cruise of the Michigan Section, N. E. L. A., there was a rejuvenation of the Jovian Order on board the steamer *Rochester* while the vessel was en route from Alexandria Bay to Toronto on Lake Ontario. Statesman H. C. Sterling, of Three Rivers, Mich., who was also president of the section, presided. A class of thirteen was initiated. The degree team was impersonated as follows: Jupiter, Mr. R. J. Kirchner; Neptune, Mr. J. T. Pearson; Pluto, Mr. E. F. Rhod; Vulcan, Mr. T. J. Tighe; Mercury, Mr. Perry R. Boole; Hercules, Mr. J. F. Lamar; Mars, Mr. T. L. Lowe; Apollo, Mr. S. C. MacNeil; Avrenim, Mr. R. R. Thomson.

* * *

NEW YORK COMPANIES' SECTION, N. E. L. A.—Six hundred members of the New York Companies' Section of the National Electric Light Association held their annual meeting and banquet at the Hotel Astor, New York City, June 17. At the afternoon session résumés of the Philadelphia convention papers were presented and the following officers were elected: Chairman, Mr. J. E. Phillips, Richmond; vice-chairman, Mr. W. J. Clark, Westchester; treasurer, Mr. W. L. Bruce, Westchester; executive secretary, Mr. F. C. Henderschott, New York, and recording secretary, Mr. J. A. Burke, New York. Mr. Clark presided as toastmaster at the evening banquet and addresses were made by Messrs. J. W. Lieb, Jr., H. H. Scott, Frank W. Smith and C. G. M. Thomas.

A Motor-Driven Raw-Water Ice Factory in Brooklyn

The newly completed 150-ton plant of the Bay Ridge Ice Company—Electric operation and control of pumping and compressor equipment—Stationary cans in freezing tank. By E. A. Leslie

ONE of the most interesting developments of central-station service in recent years has been the adaptation of electric motor drive to the making of artificial ice. The practicability of this method of drive has recently been further greatly extended through the introduction of the raw-water and multiple-effect evaporator systems, both of which do away with the necessity of steam-driven units for economical operation, providing in this way an ideal field for the electric motor. From the central-station standpoint such a load is one of most desirable characteristics, and special rates have been introduced by a number of the large electric companies in order to secure this class of business.

While ice plants are generally designed to operate twenty-four hours a day throughout the year, their operating conditions can be so arranged that during the peak loads of the central station in November, December, January and February the ice plants can shut off their power demand from 4 p. m. to 8 p. m. and still make their full quota of ice during these months. During the winter months, again, the ice companies use less power than at other periods of the year as there is a smaller demand for their product. Since the central station's heaviest loads occur during the winter season, the acquisition of this ice-making business obviously enables the central station to equalize its load throughout the year and so raise its load-factor.

Since the off-peak rates have been put in force numerous ice factories operated by electric power have been placed in operation. An example of this method of drive is found in the new factory of the Bay Ridge Ice Company, of Brooklyn, N. Y., which uses energy from the mains of the Edison Electric Illuminating Company of Brooklyn.

Service Supply to Bay Ridge Factory

The Bay Ridge plant is on Sixty-second Street between Sixth and Seventh Avenues, Brooklyn, and is supplied with energy directly from the Bay Ridge station of the Edison company through duplicate feeders, this line being run underground some eleven blocks for the exclusive use of this customer. The present ice-making capacity is 150 tons each twenty-four hours,

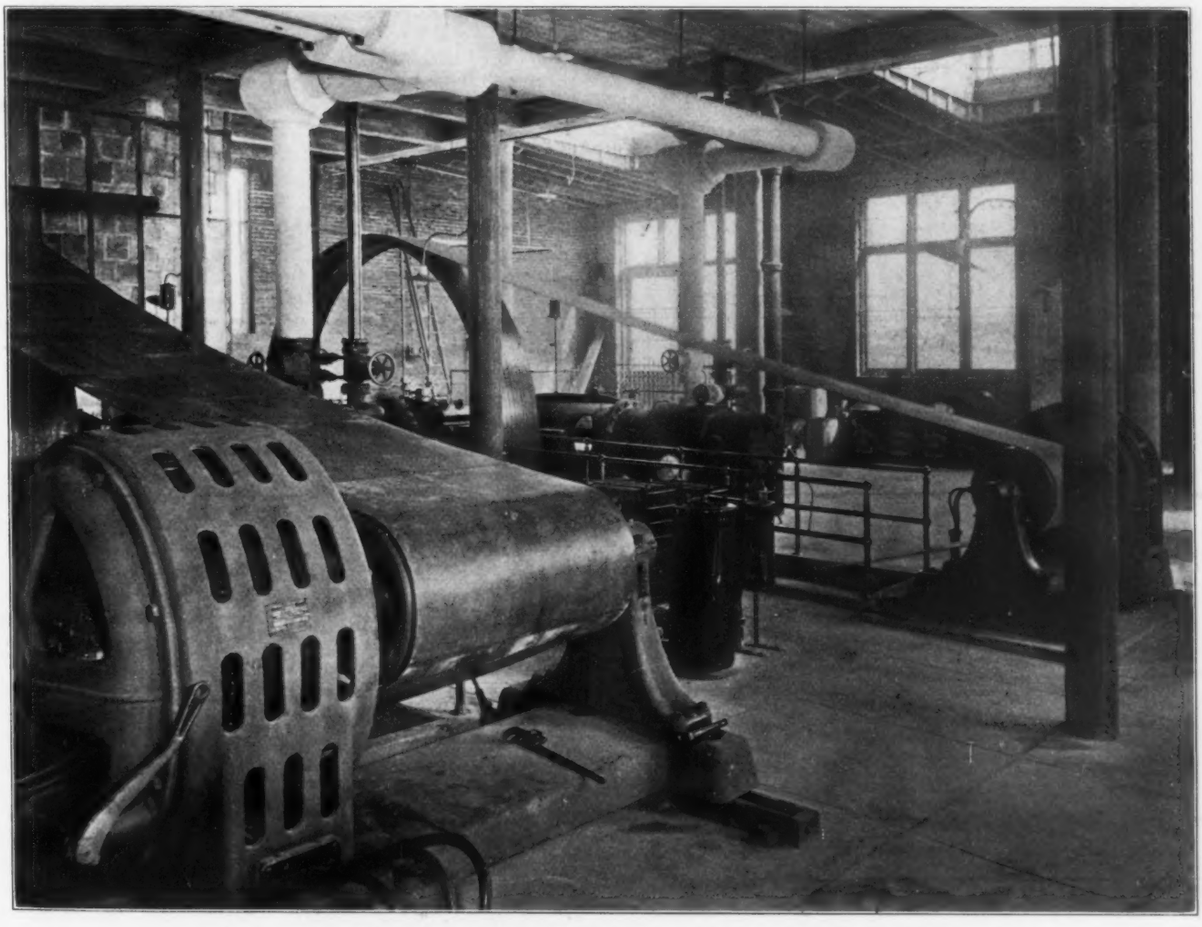


FIG. 1—COMPRESSOR ROOM IN MOTOR-DRIVEN ICE FACTORY, BROOKLYN, N. Y.

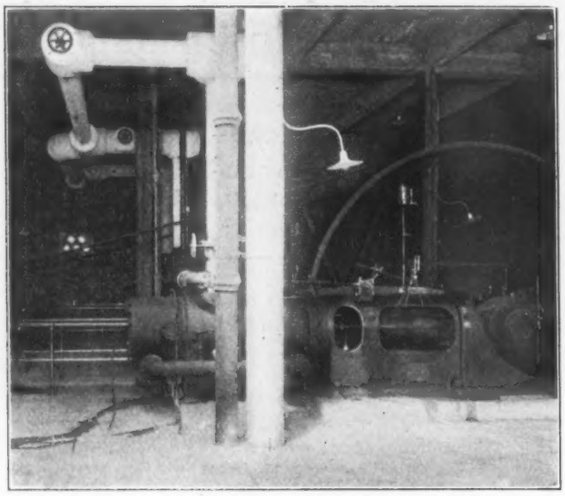


FIG. 2—100-TON ICE MACHINE

although ample provision has been made for doubling this in the near future.

The three-phase, twenty-five-cycle, 6600-volt service enters the plant underground at the front of the building and runs to the high-tension switchboard; from there the lines extend up one story into a fireproof transformer vault.

There are at present installed in this vault, which measures 20 ft. by 5 ft., three General Electric 150-kva, 6600/460-volt air-cooled transformers. Circulation of the air in the vault is effected by drawing the air in through two lattice windows in the front of the building at the floor level and then exhausting this air through two vents in the top of the transformer vault out over the roof of the building. There is also a 10-kva transformer for lighting purposes, which is connected to one leg of the secondary busbars of the main transformers.

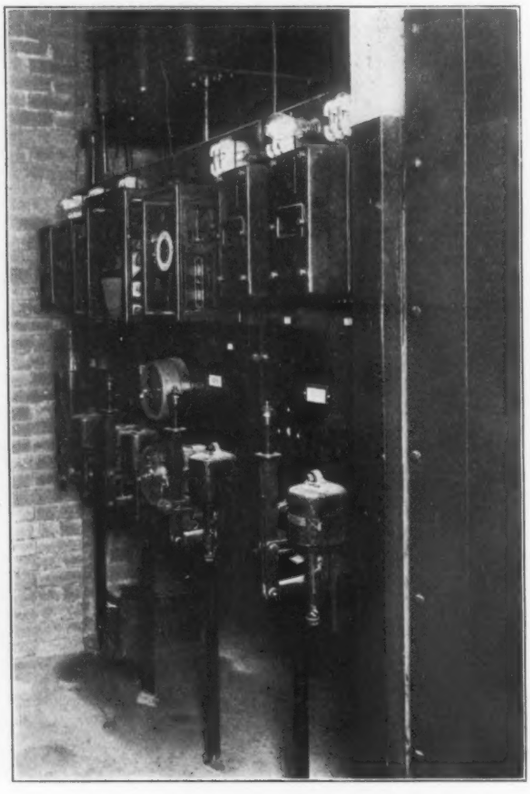


FIG. 3—HIGH-TENSION SWITCHBOARD

The high-tension switchboard is installed on the ground floor directly under the transformer vault and is also provided with a fireproof inclosure. Mounted on the board are four oil switches, two of which are installed on the duplicate feeders, the third on the line to the transformer bank, and the fourth held in reserve for future additions. Both of these feeders are alive, and either one may be pressed into instant use by simply throwing its respective oil switch. In addition to the necessary watt-hour meters for registering the energy consumption, there is also a polyphase Westinghouse curve-drawing wattmeter, one polyphase General Electric demand indicator, and one Minerallac Company's printometer. The desirability of the ice-making load on the central station's lines is admirably proved by the steadiness and length of the curve recorded by the graphic meter throughout the twenty-four hours.

From the secondaries of the transformers, the line runs to the low-tension switchboard installed on the ground floor in the compressor room. On this board are installed the main oil switch with its no-voltage release, two oil switches, one for each of the ice-machine lines, and two auxiliary switches for the small motors throughout the plant. Here are also the necessary indicating voltmeters and ammeters on the lighting and motor circuits, and two recording wattmeters—one on each ice machine—for checking purposes. Each ice machine is protected by an overload relay in addition to the shunt trips on the oil switches.

Main Compressor Equipment

In the compressor room are installed a 50-ton ice machine and a 100-ton ice machine, both of which were manufactured by the Arctic Ice Machine Company, Canton, Ohio, and operate at 65 r.p.m. The 100-ton unit is belt-driven by a 300-hp General Electric induction motor, operating at 500 r.p.m. A 150-hp motor of the same type is belt-connected to the 50-ton unit. Both of these motors are of the constant-speed type and have proved themselves thoroughly adapted to this class of work. This is of special interest in view of the fact that variable-speed motors have been considered by many to be essential for satisfactory compressor drive.

Water for the plant is supplied by a deep-well pump in the compressor room driven by a General Electric 20-hp induction motor. A small auxiliary compressor supplies the necessary refrigeration to the cold-storage rooms when the large compressors are not running. It is also used for charging the system and for pumping out. This machine has a refrigerating capacity of 6 tons and is driven by a 7.5-hp squirrel-cage General Electric induction motor.

The tank room, where the ice is made and harvested, is on the second floor of the main building, with the storage room directly below it on the ground floor. This arrangement obviates the need of any additional power for delivering ice from the tank room to the storage compartment, as the blocks are lowered by gravity directly into the storage room and thence out onto the selling platform.

Tank Room and Method of Freezing

The tank room is divided into three 50-ton units, each unit containing ten 10-ton ice-making tanks and each tank containing sixty-six 300-lb. cans. As forty-eight hours is required for a complete "freeze," it is necessary to have an installation of double the capacity of the twenty-four-hour rating of the plant, each 10-ton tank being harvested once every two days.

The raw-water system of ice making, as its name infers, does away with the necessity for distilled water.

Its operation is based on the principle that the process of freezing consists of the formation of small crystals of pure water in the form of ice and that, in so forming, materials or impurities in the water are eliminated from the crystals.

As the formation of ice begins at the sides of the can and works toward the center, all impurities are gradually pushed toward the center of the cake. Any materials in suspension in the water are eliminated from the cake by the agitation of the water, caused by a current of air entering at the bottom of the can. This prevents the particles from remaining stationary on the surface of the ice that is being formed. Likewise, any gases which come from the water are swept upward by this current of air and escape into the atmosphere. From the foregoing it will be obvious that the last part of the cake to be frozen is the center, which is known as the "core," and that all impurities will collect at this point. When the freezing has proceeded nearly to the center of the block the core water containing the impurities is drawn off and the core refilled with pure water. The block is then frozen solid.

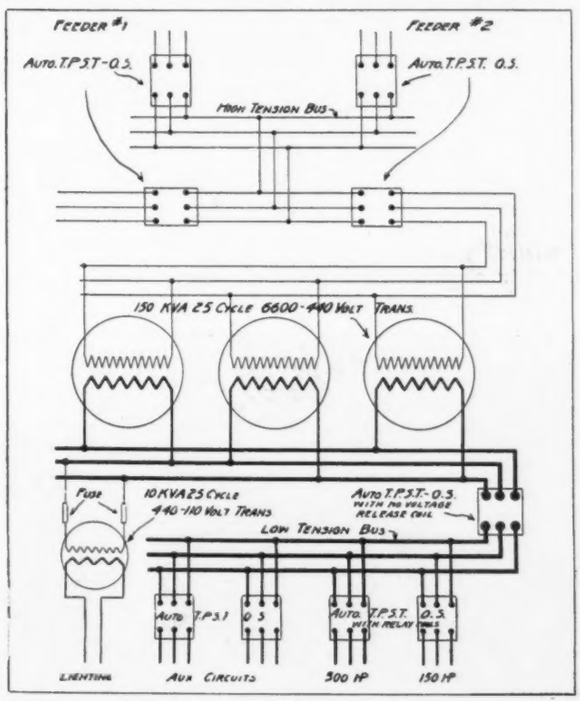


FIG. 4—DIAGRAM OF CONNECTIONS

In the Arctic-Pownall raw-water system employed at the Bay Ridge plant the bottom of each can is provided with an air inlet, a water inlet and a water outlet. Raw water to be frozen enters through the water-inlet pipe and is agitated by the air passing up through the bottom of the can. During this action the impurities which are drawn off are carried away through the water-outlet header into what is known as the precipitating tank. There is one of these for each 10-ton ice-making tank. The air in entering the cans also produces a siphon or ejector action which causes the water to flow into the cans through the inlet-water header, thus raising the height of water therein to a level slightly above that of the water in the precipitating tank. The water is drawn in at the rate of about one gallon an hour, and the same amount flows back into the precipitating tank, carrying away all impurities from the raw water and depositing them in the precipitating tank. This cyclic action continues until the end of each freeze, when the impurities thus deposited are removed by the core water in the cans, which flushes out the tanks.

FIG. 5—CONDENSER ROOM

Stationary Freezing Cans

For agitating the water in the cans there are two positive air blowers, each driven by a 7.5-hp motor and furnishing air at about 3 lb. pressure. The air is forced directly into the bottom of each can throughout the entire unit in equal quantities and at the same pressure by opening a single controlling valve. Likewise each of the sixty-six-can 10-ton tanks is filled by opening a single valve which allows the water to flow from the storage tank, of which there are three, one for each 50-ton unit, into the bottom. Filling continues until a predetermined height is reached, which is controlled by an overflow. Just before the cans are filled the air for agitating the water is turned on to the entire unit, each can getting the same quantity of air by special arrangement. After the water has been allowed to run into the cans, cold brine is let into the freezing compartments, thus permitting the circulation of the brine

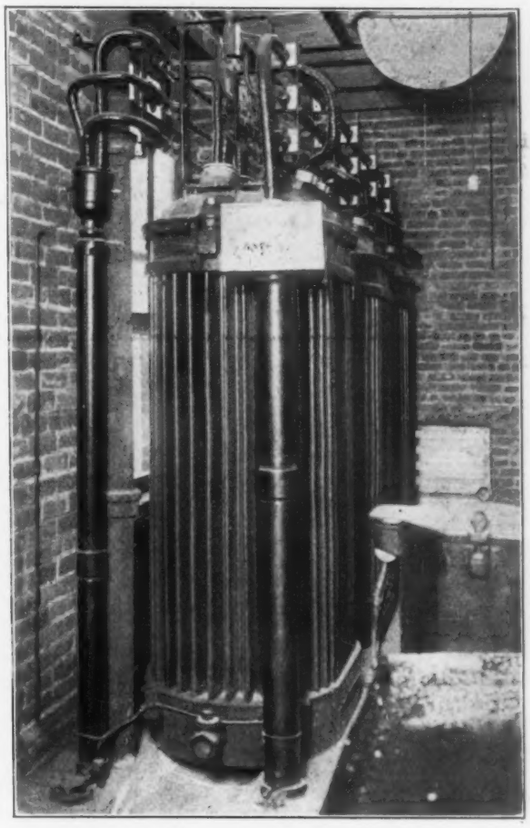


FIG. 6—TRANSFORMER SERVING ICE FACTORY

around the cans. The water is then frozen to a point where there remains a hole about 0.5 in. wide throughout the length of the block. The water therein is next drained off through the precipitating tank by opening the core-water drain valve. The drain valve is then closed and the core filled with fresh raw water and the freezing allowed to continue until the blocks are completely frozen. A small boiler is required for the heating plant during the winter season.

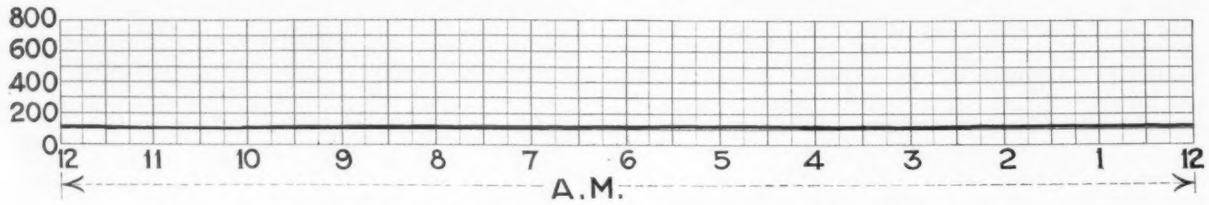


FIG. 7—TYPICAL LOAD CURVE OF MOTOR-DRIVEN ICE PLANT

Circulation of Brine

When the freezing process has been completed the cold brine is shut off and the blocks are allowed to stand for about three-quarters of an hour. The brine is then circulated by means of a pump, sometimes termed the "warm brine" pump, from the brine tank through a coil in the storage-water tank and back around the cans, in this way cooling the supply of make-up water and at the same time increasing the brine temperature to about 38 deg. Fahr. This circulation of brine thaws the ice from the sides of the cans and facilitates harvesting. Three centrifugal pumps directly connected to three 5-hp General Electric squirrel-cage motors are utilized to furnish this brine circulation.

It should be noted that in this plant the cans themselves are not pulled, being fastened to the bottom of the tank, but that, in harvesting, the ice is pulled from the cans by means of two small hooks which were at the outset placed over the edges of the can and frozen against the block. This feature minimizes the labor in handling the cakes.

A pneumatic crane is used in hoisting the blocks of ice from the cans, air being supplied for this purpose at 60 lb. pressure by a small compressor in the tank room which is driven by a 5-hp squirrel-cage General Electric motor.

The condenser room is directly over the compressors. At the present time there are installed here three ammonia double-pipe condensers, each bank of which is of sufficient capacity to handle a 50-ton ice-making plant. Sufficient space is provided in this room for taking care of future growth of business necessitating an output twice as great, or 300 tons.

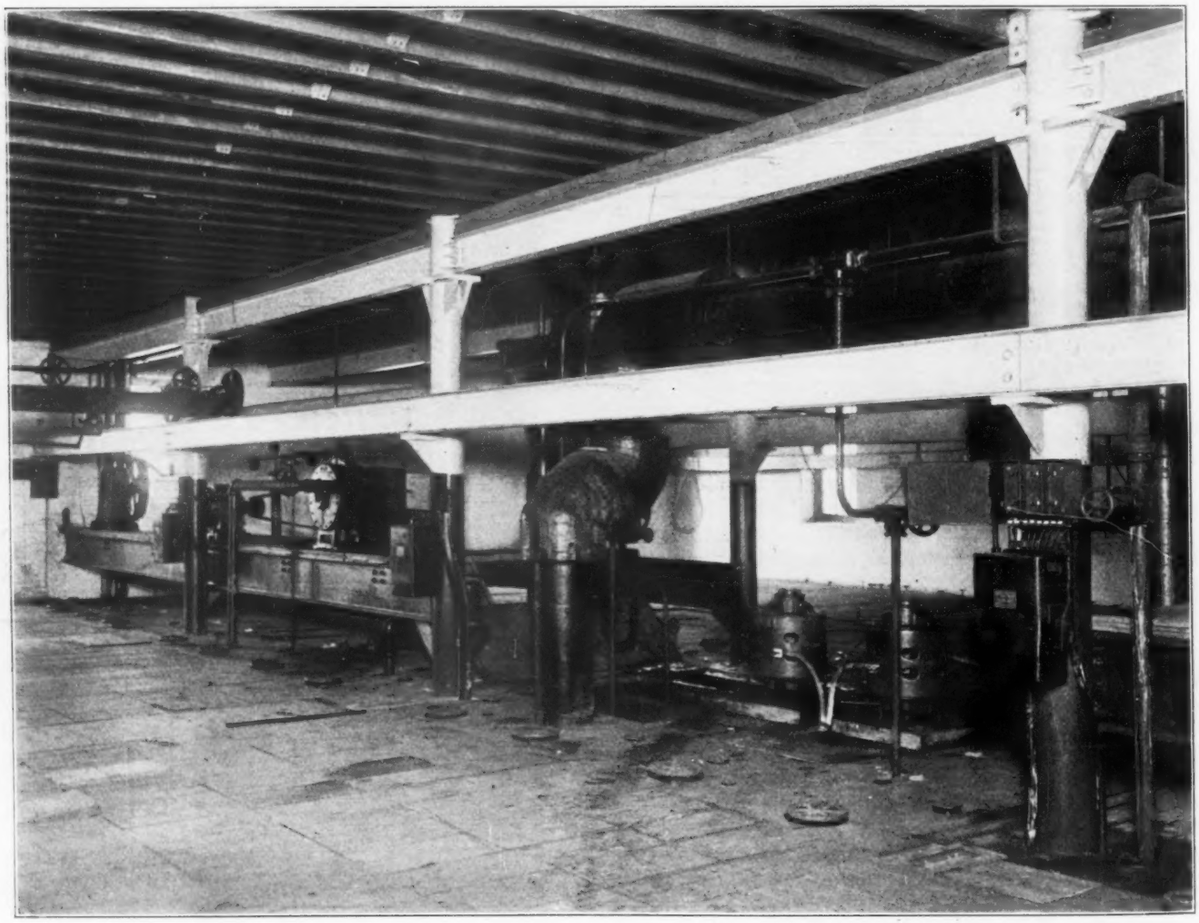


FIG. 8—TANK ROOM, SHOWING PUMP MOTORS, STARTING APPARATUS, ETC.

COMMUTATION—II

BY ALFRED STILL

WITH a view to calculating within a reasonable degree of accuracy the flux density in the zone *ABC* of Fig. 6, it is necessary to make certain assumptions and to use judgment in applying the calculated results, because it is not possible to determine this value with scientific accuracy even when the exact shape of the armature coils and the configuration of the surrounding masses of iron are known.

In the first place, the angle α of Fig. 6 will be taken as 45 deg., which, although perhaps slightly greater than the average on modern multipolar machines, has the advantage that it permits us to treat the wires *AB* and *BC* as being at right angles to each other. The further assumption will be made that the armature is of large diameter, and the developed view of the end connections, as shown in Fig. 7, can therefore be considered as lying in the plane of the paper. The flux in the zone occupied by the portion *AB* of the coil undergoing commutation is due to the currents in all the neighboring parallel conductors comprised in the parallelogram *ADBC*. The direction of flow of current in these parallel conductors is indicated by the arrows, being outward (i.e., from *A* to *B*) on the left-hand side of the commutating zone, and inward (from *B* to *A*) on the right-hand side. The intensity of the field produced on *AB* by any one of these wires, if the lines of force are assumed to be circles in a path consisting entirely of air (the proximity of masses of iron being for the present ignored), will be inversely proportional to the distance of the wire considered, and the extent to which this wire will be effective in producing a field along *AB* will depend upon its length. Thus, a conductor such as *EF* will produce not only a stronger component of the resulting field in the commutating zone than the wire *GH*, but a field of which the extent is measured by the length *EF*, while the more distant wire will produce a weaker field over a length equal to *GH* only. Thus the effect of the more distant wires in building up the flux over the commutating zone decreases very rapidly with increase of distance. Fig. 8 represents a section at right angles to the conductor *AB* of Fig. 7. It is assumed that the brush covers two bars (a reasonable, but not a necessary, assumption),[1] and the condition shown in Fig. 8 corresponds to the middle of the commutation period, with zero current in the short-circuited coil and full armature currents of $+I_c$ and $-I_c$ respectively in the neighboring conductors.

Considering the full pitch coil of pitch τ centimeters measured over the armature surface, we can write

$$\tau = n\lambda$$

where n = number of slots per pole, and λ = slot pitch in centimeters. Then the length *AB* (Fig. 7), which is approximately one-quarter of the total length of "inactive" copper per coil, is

$$l = \frac{\tau}{\sqrt{2}} = \frac{n\lambda}{\sqrt{2}}$$

and the pitch of the end windings (which are supposed to lie in the same plane as the conductors in the slots) will be,

$$a = \frac{\lambda}{\sqrt{2}} = \frac{l}{n}$$

Let T = number of conductors or turns per coil (which is not necessarily the same as the number of turns between commutator bars, because there may be more commutator bars than there are slots on the armature), and let I_c = the amperes of current per conductor; then, since the field intensity at a distance y cm from a straight conductor is

$$H = \frac{0.2 \times \text{current in amperes}}{y}$$

we may write, for field intensity due to the group of conductors *EF*,

$$H_{ef} = \frac{0.2 \times TI_c}{2a}$$

The flux produced in the zone *AB* by the same group of wires (*EF*) will be proportional to the value of H multiplied by the length *EF*. Thus, in a zone 1 cm wide, of which the center line is *AB*, the flux of induction due to the conductor *EF* is

$$\Phi_{ef} = \frac{0.2\,TI_c}{2a}(l - 2a)$$

The sum of all such elements of the total flux, taken

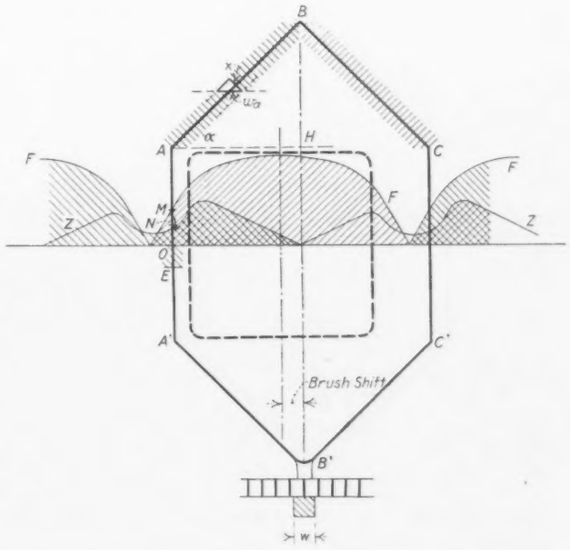


FIG. 6—CORRECTION FOR CUTTING OF END FLUX

for all the parallel conductors on both sides of *AB* will be

$$\Phi_c = \frac{0.4\,TI_c}{a}\left[(l-a) + \frac{l-2a}{2} + \frac{l-3a}{3} + \cdots + \frac{l-na}{n}\right]$$

which, bearing in mind the relation $l = an$, simplifies into

$$\Phi_c = 0.4\,TI_c n\left(\frac{1}{2} + \frac{1}{3} + \frac{1}{4} \cdots + \frac{1}{n}\right) \qquad (4)$$

The total flux (maxwells) cut by the end connections *ABC*, being one-half of the length of "inactive" copper in the commutated coil, is given by the expression

$$\Phi_t = 2\,\Phi_c \times w_a \sin\alpha$$
$$= \sqrt{2}\,\Phi_c \times w_a$$
$$= 0.4\sqrt{2}\,TI_c n\,w_a\left(\frac{1}{2} + \frac{1}{3} + \frac{1}{4} \cdots + \frac{1}{n}\right) \qquad (5)$$

in which w_a is, as before, the brush arc expressed in centimeters of armature periphery.

[1] Within practical limits, the width of the brush does not appreciably affect the average density of the armature flux cut by the commutated coil. A wide brush, by short-circuiting several coils, reduces the number of conductors carrying the full armature current, and to this small extent the total mmf producing the flux in the commutating zone is less with a wide brush than with a narrow brush.

The average flux density over the zone considered is

$$B_e = \frac{\Phi_e}{l} = \frac{0.4\sqrt{2}k\,T\,I_c}{\lambda}\left(\frac{1}{2}+\frac{1}{3}+\frac{1}{4}\quad .\quad .\quad +\frac{1}{n}\right) \quad (6)^2$$

This assumes air paths for the flux lines, but on account of the proximity of the pole shoes to the points where the end connections leave the slots, and also because the conductors actually remain parallel to the shaft for a short distance beyond the core, the value of B_e would be larger than as given by formula (6). A constant should therefore be included, and if the convergent series is replaced by the logarithmic function, the formula becomes,

$$B_e = \frac{0.4\sqrt{2}\,kTI_c}{\lambda}\,[(\log_\epsilon 2n) - 1] \qquad (7)$$

This value of B_e may be used in formula (3) to calculate the equivalent density, B_a, of the total flux to be cut by the slot conductors in the commutating fringe, in order to counteract the emf generated in the end connections by their movement through the field of density B_e.

If the end coils lie on a cylindrical support of iron or steel, the reluctance of the flux paths is very nearly

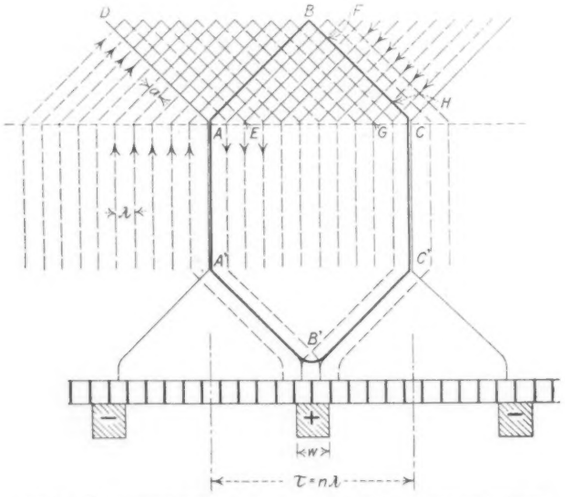


FIG. 7—DEVELOPED VIEW OF END CONNECTIONS

halved, and the value of k in formula (7) should therefore be doubled. If it is desired to consider the increased flux due to the use of steel binding wires or bands, this can be done by making a suitable correction to the factor k.[3] Should it be desired to calculate separately the average value of the total emf generated in the end connections of the short-circuited coil, we have

$$E_e = \frac{B_e l_e v\,T}{10^8}$$

where l_e = total length of coil outside armature slots (both ends)

$= 2\sqrt{2}\,\lambda\,n$, if we keep to the assumption of angle $\alpha = 45$ deg.

and v = speed of cutting in centimeters per second,

$= \dfrac{\pi D R_s}{\sqrt{2}}$, in which D is the armature diameter in centimeters, and R_s is the speed in revolutions per second. The factor $\sqrt{2}$ is the necessary correction to give the component of the velocity at right angles to the conductor. Inserting the value of B_e given by formula (7), and making the required simplifications, the formula for voltage becomes

$$E_e = \frac{k \times 0.8\sqrt{2}\,n\,I_c T^2\,(\pi D R_s)\,(\log_\epsilon 2n - 1)}{10^8} \qquad (8)$$

The numerical value of k in multipolar machines of modern design will usually lie between 1.3 and 3.5, the high value being taken when the end connections lie on a steel or iron supporting cylinder against which they are held by bands of steel wire.

For first approximations the formula may be put into simpler form:

Let A_c stand for the ampere-conductors on armature periphery per pole pitch ($A_c = 2TnI_c$). Let $k = 2.4$ (being an average value), and for the quantity $(\log_\epsilon 2n - 1)$ put the numerical value 2.2 (the assumption here being that there are twelve to fourteen slots per pole), then

$$E_e \text{ (approximately)} = \frac{3\,T\,A_c v}{10^8} \qquad (9)$$

where v is, as before, the peripheral velocity of the armature in centimeters per second.

The above calculations and conclusions are based on the assumption of a full pitch winding. With a chorded or short-pitch winding, the average flux density in the commutating zone will be slightly reduced; and there will be a further gain due to the shortening of the end connections (ABC and $A'B'C'$ in Fig. 6). Thus the voltage generated by the cutting of the end fluxes, with a short pitch winding, will be slightly less than the value calculated by formula (8), or by the approximate formula (9), which applies to a pitch winding.

Calculation of "Slot Flux" Cut by Coil During Commutation

A reference to the diagrams of flux distribution in the commutating zone (Figs. 4 and 5) will make clear the fact that, even when the effect of the end connections is neglected, the center of the neutral commutating zone is not the point on the armature periphery where flux neither enters nor leaves the teeth; because in order that the short-circuited conductors shall not cut the slot leakage flux, this flux must be provided by the main field pole toward which the brushes are shifted to obtain perfect commutation. The point on the armature periphery where flux neither enters nor leaves the teeth may be found by drawing curves representing the magnetomotive forces exerted by field poles and armature windings at every point on the armature periphery, and where the sum of the ordinates of such curves is zero the surface flux density must also be zero. The brushes must, however, be moved forward beyond this point until the reversing flux entering the teeth comprised in the brush arc has the value Φ_t as given by the formula (5), to compensate for the end fluxes plus the total slot flux Φ_s, which is twice the leakage from tooth to tooth in one slot when the conductors are carrying the full armature current.[4] In order to calculate the volts generated in the coil of T turns by this slot leakage flux, it is the *equivalent* slot flux that must be considered, because the total number of lines crossing between the sides of adjacent teeth does not link with all the wires in the coil.

[2] The value of the series in the brackets is readily computed with the aid of a table of reciprocals, but if preferred this series can be put in the form $(\log_\epsilon 2n) - 1$, which is really more accurate, since it assumes a current uniformly distributed through the copper section of the conductors instead of being concentrated at the center of each coil as assumed in deriving formula (4).

[3] This is discussed by Mr. Lamme in his Institution paper previously referred to.

[4] In the case of short-pitch windings, or when there are more commutator bars than there are slots on the armature, the amount of the slot flux must be calculated for the instant when the coil enters or leaves the commutating zone. This flux will depend not only upon the dimensions of the slot but also upon the current carried by each conductor and the position of the latter in the slot.

It will be convenient to assume the same number of slots as there are commutator bars, and the whole of the slot space to be filled with $2T$ conductors, each carrying a current of I_c amp (this follows from the assumption of a full pitch winding). Thus no account will be taken of the fact that a small space occurs between upper and lower coils, where the slot flux will not pass through the material of the conductors. The lines of the slot flux will be supposed to take the shortest path from tooth to tooth; the small amount of flux that may follow a curved path from corner to corner of tooth at the top of the slot will be neglected. Refinements of this nature may be introduced, if desired, when solving the problem for a concrete case.[5] If the usual assumption is made that the reluctance of the iron in the path of the magnetic lines is negligible in comparison with the slot reluctance, the small portion of slot flux in the space dx (Fig. 9) considered 1 cm long axially (i.e., in a direction perpendicular to the plane of this paper) is

$$d\Phi = \text{mmf} \times dP$$

where dP is the permeance of the air path. Thus,

$$d\Phi = 0.4\pi\,(2TI_c)\,\frac{x}{d} \times \frac{dx}{s}$$

but this flux links with only $2T \times \frac{x}{d}$ conductors, and the *equivalent* slot flux, which would generate the same emf if cut by all the conductors in the slot, is therefore

$$d\Phi_s = d\Phi \times \frac{x}{d}$$

and

$$\Phi_s = \frac{0.8\pi TI_c}{d^2 s}\int_o^d x^2 dx = \frac{0.8\pi d}{3\ s}\,TI_c \qquad (10)$$

This is the equivalent flux in maxwells per centimeter of axial length of armature slot. If l_a = axial length of armature core expressed in centimeters[6], the total slot flux cut by each coil side during commutation, being *twice* the flux per slot, as shown in Fig. 4, is

$$\Phi_s = \frac{1.6\pi}{3}\,\frac{d}{s}\,TI_c l_a \qquad (11)$$

The voltage component due to the cutting by *both* coil sides[7] of the slot flux considered separately from other fluxes would be

$$E_s = \frac{2\Phi_s T}{10^8\, t_c}$$

where the time of commutation

$$t_c = \frac{\text{brush arc in centimeters of armature periphery}}{\text{peripheral velocity in centimeters per second}} = \frac{w_a}{v}$$

Thus,

$$E_s = \frac{3.2\pi T^2 I_c d\, l_a v}{3 \times 10^8\, s\, w_a} \qquad (12)$$

The factor w_a in the denominator of this formula indicates that the slot flux is of less importance with a wide than with a narrow brush. This is generally true, although it must be remembered that the formula (12), in common with other formulas previously developed, is not of general application. Within the limits of this article, it is not possible to consider all special cases; and commutation formulas of general applicability cannot be developed. When there is more than one coil per slot, and when there are "dead coils," inequalities occur which complicate the problem and make it impossible to obtain ideal commutation with every coil on the armature. In such cases the slot flux must be calculated for the coils that are differently situated in regard to the brush position and an average value selected for use in the calculations.

Knowing the slot flux Φ_s and the previously calculated end flux Φ_t cut by the conductors of the short-circuited coil while traveling over the distance w_a, the correct brush position is found when the reversing flux entering the teeth comprised in the commutating zone of width w_a is approximately $\Phi_s + \Phi_t$ maxwells. The flux actually cut by the one coil side is, however, only Φ_t; the component Φ_s of the total flux entering the commutating zone merely supplies the leakage from tooth to tooth across the slot. The presence of the slot flux undoubtedly tends to complicate the problem of commutation. It should be noted that the slot flux Φ_s, if calculated by formula (11), is what has been referred to as the equivalent slot flux; that is to say, a flux of this value, if cut by an imaginary concentrated winding

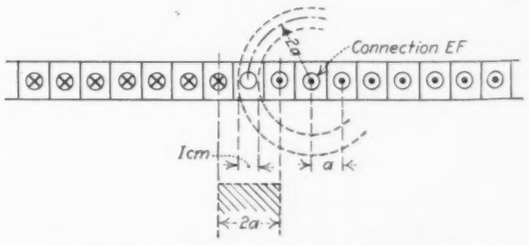


FIG. 8—FLUX DUE TO END CONNECTIONS

of T turns, would develop the same voltage in the coil as the actual slot flux develops in the actual winding. The condition of importance to be fulfilled is simply that the "equivalent" flux cut by the coil side in the reversing field shall have the value Φ_t. This may be separated into two parts, (1) the flux passing through the teeth into the armature, which links with *all* the conductors in the slot, and (2) the equivalent slot flux. It is important to note that although the total or actual slot flux is the same whether it enters the top or the root of the tooth, the flux linkage and therefore the developed voltage have not the same value in the two cases. The total slot flux, on the basis of the assumptions previously made, is

$$\Phi_s\ (\text{total}) = \frac{2 \times 0.4\pi\,(2TI_c)\,l_a}{ds}\int_o^d x\,dx = \frac{0.8\pi\, d\, TI_c l_a}{s} \qquad (13)$$

being one and one-half times the equivalent slot flux given by formula (11). The equivalent flux when the total slot flux enters the tooth top instead of passing through root of tooth is no longer expressed by formula (11); it may be calculated thus:

The magnetic lines represented by the expression $d\Phi = 0.4\pi\,(2TI_c)\,\frac{x}{d}\,\frac{dx}{s}$ no longer link with $2T\,\frac{x}{d}$ conductors, but with $2T\,\frac{x\,(d-x)}{d}$ conductors. The equiv-

[5] With short-pitch windings, or when there are several coils per slot, all the conductors in the slot may not be carrying the full armature current when the coil enters or leaves the commutating zone. In such cases the actual conditions must be studied, and an average value for the slot flux can readily be arrived at. If necessary, the straight-line law of commutation may be assumed in order to estimate the current values in the coils passing through the intermediate stages of commutation.

[6] It is well to let l_a stand for the gross length of armature core, although in slot flux calculations the total width of vent ducts is sometimes deducted.

[7] The $2T$ conductors in the one slot are here considered as equivalent to the two coil sides, each of T wires, in separate slots one pole pitch apart.

alent flux, when no part of this flux passes into the armature core below the teeth, is therefore

$$\Phi_s = 2l_a \int_o^d d\,\Phi \times \frac{d-x}{d}$$
$$= \frac{1.6\,\pi\,TI_c l_a}{d^2 x} \int_o^d x\,(d-x)$$
$$= \frac{1.6\,\pi\,d}{6s}\,TI_c l_a \qquad (14)$$

or just half the equivalent slot flux as given by formula (11). The question now arises: What is the necessary total flux entering the tops of the teeth comprised in the commutating zone to develop the proper voltage component in the short-circuited coil?

A total slot flux as given by formula (13) has the "equivalent" value as given by formula (14); that is to say, it is—on the basis of the assumptions previously made—three times as great as the equivalent flux. The total flux entering the teeth comprised in the commutating zone should therefore be

$\Phi_c = 3\,\Phi_s' +$ flux passing directly into armature core through the teeth.

$= 3\,\Phi_s' + \Phi_d$

but $\Phi_s' + \Phi_c = \Phi_t$ where Φ_t is, in this particular instance, the equivalent value of the total flux to be cut by

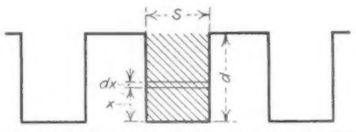


FIG. 9—ILLUSTRATING SLOT FLUX CALCULATIONS

the "active" portion of the short-circuited conductors. Thus

$$\Phi_c = 2\,\Phi_s' + \Phi_t$$
$$= \Phi_s + \Phi_t$$

where Φ_s is the equivalent slot flux as originally calculated and expressed by formula (11).

The flux actually entering the armature teeth in the commutation zone should therefore be equal to the sum of the end flux Φ_t and the equivalent slot flux Φ_s. It is because this conclusion is not obvious that it has been deduced from the foregoing arguments.

Commutating Interpoles

Assuming the same number of interpoles as there are main poles and an axial length of interpole equal to that of the main pole, the flux from each interpole which enters the armature teeth included in the commutating zone of width w_a is, as before, $\Phi_s + \Phi_t$.

If, as is usually the case, the interpole face does not cover the whole length of the armature core, then some flux due to the total mmf of the armature windings will enter or leave the armature core by the teeth included in the commutating zone, and this flux will be cut by that portion of the slot conductors which is not covered by the interpole. With the brushes at the geometric neutral this armature flux is unaffected by the excitation of the main poles; its value depends only upon the armature ampere turns and the reluctance of the air paths between armature surface and the neighboring masses of iron. It can be predetermined within reasonably close limits, but the calculation of flux distribution on armature surface is beyond the scope of this paper. If Φ_a is the total flux leaving the armature in the commutating zone over a space w_a wide and l_a long—where l_a is the gross length of the armature core and w_a is, as before, the brush arc referred to the armature periphery—the portion of this flux which is cut by the short-circuited wires in the space beyond the interpole of length l_p is $\Phi_a \left(\frac{l_a - l_p}{l_a}\right)$, and the flux entering the armature from each interpole should be approximately $\Phi_s + \Phi_t + \Phi_a \left(\frac{l_a - l_p}{l_a}\right)$. Knowing the amount of the flux to be provided by each interpole, its cross-section can be decided upon and the necessary exciting ampere-turns calculated, bearing in mind the following requirements:

(a) The average air-gap density should be low (about 6000 gausses corresponding to full load current), to allow of increase on overloads.

(b) The leakage factor should be as small as possible. This involves keeping the width and axial length of interpole small, thus conflicting with condition (a) and presenting one of the difficulties of commutating-pole design.

(c) The minimum width of pole face is such that the equivalent pole arc (which must include an allowance for fringing) shall cover the commutating zone of width w_a.

(d) The equivalent pole arc should, if possible, be an exact multiple of the slot pitch (either once or twice the slot pitch) as this tends to reduce the magnitude of the flux pulsations in the interpole. The effects of these flux pulsations, caused by variations in the reluctance of the interpole air-gap, are, however, usually of no great practical importance, but the width of brush should not be determined independently of the interpole design.

(e) In order to keep down the I^2R losses in the series turns on the interpole (usually amounting to less than 1 per cent of the total output), the ampere-turns and the length per turn should be as small as possible. The gain resulting from a small air-gap is, however, not great, because the ampere-turns required to overcome the air-gap reluctance rarely exceed 25 per cent of the total, the balance being required to oppose the armature mmf. A reasonably large air-gap has the advantage of reducing the flux pulsations referred to under (d).

(f) The effect of the interpole being to increase the flux in that portion of the yoke which lies between the interpole and the main pole of opposite polarity, it is important to see that the resulting flux density in this part of the magnetic circuit is not excessive. A similar condition exists in the armature core, but this does not usually determine the limits of the allowable average flux density below the teeth.

(g) Series-wound or wave-wound armatures are to be preferred on machines with commutating poles, especially when the air-gap under the main poles is made smaller than it would have to be if interpoles were not used.

(h) The total line current should, if possible, pass through all the interpole windings in series; that is to say, parallel circuits should be avoided because of the possibility that the current may not be equally divided. If the total current is too great, a portion may be shunted through a diverter. The diverter should be partly inductive, the resistance being wound on an iron core in order that the time constants of the main and shunt circuits may be approximately equal. If this is not done, the interpole winding will not take its proper share of the total current when the change of load is sudden, and this may lead to momentary destructive sparking.

Among the advantages of commutating poles may be mentioned the fixed position of the brushes and the fact that fairly heavy overloads can be taken from the machine without destructive sparking, because of the building up of the commutating flux with increase of load. The limiting factor in this connection is the saturation of the iron (mainly of the interpole itself)

in the local circuit, and this is aggravated by the large percentage of leakage flux due to the proximity of main and commutating poles. Deeper armature slots may be used than in the case of machines without interpoles, and the specific loading (ampere conductors per unit length of armature periphery) may be increased, thus allowing of greater output notwithstanding the slight reduction in width of main poles necessary to accommodate the interpoles. The maximum output of the machine with commutating poles is usually determined by the heating limits, the ventilation being less effective than in the case of non-interpole machines. The I^2R loss in interpole windings is to some extent compensated for by a reduction of the ampere turns on the main poles when shorter air-gaps are used. With the brushes on the geometric neutral and an air-gap which is small relatively to the space between pole tips, field distortion *per se* has nothing to do with commutation, whether interpoles are used or not; if the fringe from the leading pole tip is not to be used for counteracting the effects of end flux and slot flux on the coil undergoing commutation, the unequal flux distribution under the main poles due to cross-magnetization does not affect the field at a point midway between two main poles. It is not suggested that field distortion is unobjectionable when the brushes are on the geometric neutral or when interpoles are used. The concentration of flux at one side of the main pole may lead to flashing over the commutator surface (an effect often attributed to unsatisfactory commutation, though rarely due to this cause); but the chief objection to a large number of ampere turns per pole is the fact that the flux in the zone of commutation due to this mmf must be compensated for somehow if satisfactory commutation is to be obtained. It is exactly in the zone corresponding to the brush position that the armature mmf has its maximum value. In the case of the interpole machine, the windings necessary to compensate for armature cross-magnetization are an objectionable feature; and, except for the added cost and tendency to interfere with ventilation, there is much to be said in favor of pole-face windings, the function of which is to neutralize the magnetizing effect of the armature winding and maintain an approximately constant flux density over the pole faces. The writer has in mind machines such as those which, for the last twenty years, have been constructed under the Thompson-Ryan patents. One of the attractive features of such designs is the fact that the winding on the commutating poles need be no greater than that required to overcome the reluctance of the air-gap and send the requisite flux into the armature teeth comprised in the commutating zone.

Example of Interpole Design

The numbers and dimensions used to illustrate the method of calculation outlined above will be chosen without reference to an actual design of interpole dynamo, and they must not be considered representative of modern practice. Assume the leading particulars of the machine to be as follows:

Output = 200 kw.
Volts = 440.
R.p.m. = 500.
Number of main poles $p = 6$.
Armature core diameter $D = 30$ in.
Armature core length $l_a = 11$ in. $= 28$ cm.
Total number of slots = 120.
Number of slots per pole $n = 20$.
Slot pitch $\lambda = 0.785$ in.
Slot width $s = 0.39$ in.
Slot depth $d = 1.5$ in.
Style of winding: full pitch, multiple.
Current per armature path $I_c = 76$ amp.
Number of conductors per slot = 8.
Total number of conductors $Z = 120 \times 8 = 960$.
Number of commutator bars = 240. (There are four coil-sides per slot, or two coils, giving two turns between adjacent commutator bars.)
Diameter of commutator = 20 in.

$$\text{Pitch of commutator bars} = \frac{\pi \times 20}{240} = 0.262 \text{ in.}$$

Number of bars covered by brush = 3.5.
Thickness of brush (brush arc) $w = 0.262 \times 3.5 = 0.916$ in.

$$\text{Brush arc referred to armature periphery } w_a = \frac{0.916 \times 30}{20} = 1.375 \text{ in.} = 3.5 \text{ cm.}$$

Assuming the same number of commutating poles as there are main poles, the flux entering the armature teeth in the commutating zone of width w_a should equal the sum of the equivalent slot flux and the end flux, together with the flux which is due to the armature

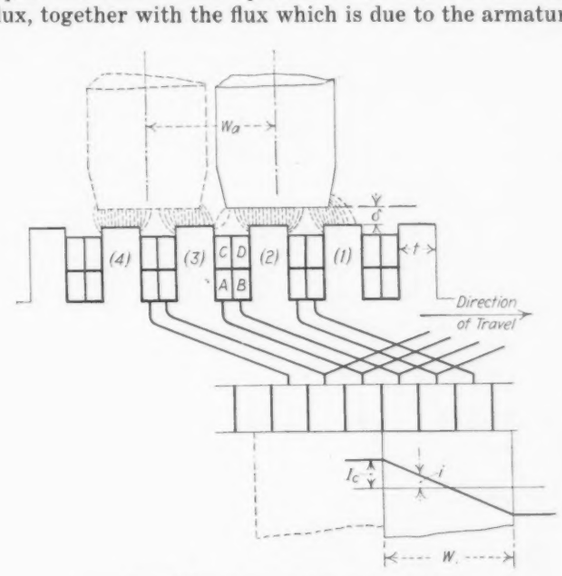


FIG. 10—FLUX FROM INTERPOLE

ampere turns and which leaves the armature core in the portion of the commutating zone not covered by the interpole. The end flux cut by the short-circuited coils is given approximately by formula (5) which may be put in the form

$$\Phi_t = 0.4\sqrt{2}\,TI_c n w_a\,[(\log_e 2n) - 1]$$
$$= 0.4\sqrt{2} \times 4 \times 76 \times 20 \times 3.5 \times (3.69 - 1)$$
$$= 32{,}400 \text{ maxwells.}$$

In regard to the slot flux, at the beginning or end of commutation (depending upon the position of the coil in the slot) the conductors in the slot affected are not all carrying the full armature current. This will be seen by reference to Fig. 10, where coil A (consisting of two turns) is just about to be short-circuited by the brush. At this instant the current in the coil-sides B and D is $i = 2I_c \times \frac{1}{3.5} = 0.572\,I_c$ as indicated by the diagram sketched on the brush of width w covering three and one-half bars, the straight-line law of current variation being assumed. At the end of commutation, when the position of the affected slot relatively to brush and interpole is as indicated by the dotted lines, the current in all four coil-sides is $-I_c$. We may therefore assume the slot flux to be produced by a current of which the average value is not $I_c = 76$ amp, but $I_c \times \frac{3 + 0.572}{4} = 68$ amp. The "equivalent" slot flux, as given by formula (11), is therefore

$$\Phi_s = \frac{1.6\,\pi d}{3\,s} TI_c l_a$$
$$= \frac{1.6\,\pi \times 1.5 \times 4 \times 68 \times 11 \times 2.54}{3 \times 0.39}$$
$$= 49{,}000 \text{ maxwells.}$$

Turning now to the flux leaving the armature in that part of the commutating belt which is not covered by the interpole, let the curve Fig. 11 represent the full-load flux distribution over armature surface, calculated on the assumption that there are no interpoles. The flux density at a point midway between the two poles has the value B, which for the purpose of this example may be assumed to be 1500 gausses.

If l_p = axial length of interpole (not yet determined), the total flux which must pass from interpole into armature teeth is

$$\Phi_p = \Phi_s + \Phi_t + B\,(l_a - l_p)\,w_a \qquad (15)$$

The axial length l_p of the interpole face can therefore

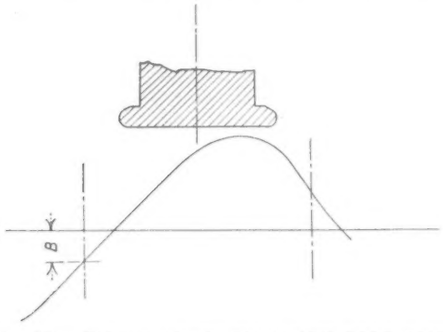


FIG. 11—FLUX DISTRIBUTION OVER POLE PITCH

be determined if a suitable value for the average air-gap density under full-load conditions is assumed. Let B_p stand for this value: then

$$B_p \times l_p \times w_a = \Phi_s + \Phi_t + B\,(l_a - l_p)\,w_a$$

and

$$l_p = \frac{\Phi_s + \Phi_t + B w_a l_a}{w_a\,(B_p + B)} \qquad (16)$$

If the flux densities are expressed in gausses, the dimensions must be in centimeters; and if B_p is taken as 4000 gausses, the length l_p is found to be 12 cm, or, say, 4¾ in.

The total flux in the interpole air-gap at full load is

$$49{,}000 + 32{,}400 + (11 - 4.75)\ 1.375 \times 1500 \times 6.45 = 164{,}500 \text{ maxwells.}$$

Assuming a leakage factor of 1.8 and a cross-section under the interpole winding of 4¾ × 1⅜, the full-load density in the core of the interpole would be 7000 gausses.

Calculation of Ampere Turns Required on Interpole

Referring to Fig. 10, it will be seen that when the coil A is about to be short-circuited, the interpole flux enters the armature through the teeth 1 and 2. At the end of commutation this flux enters the teeth 3 and 4. The permanence of the air-gap of length δ may vary slightly with the change in the position of the armature teeth; it may be calculated by any of the approximate methods. Assuming an actual air-gap ¼ in. long, the equivalent air-gap might be 0.3 in. The full-load ampere turns required to overcome air-gap reluctance will therefore be

$$\frac{0.3 \times 2.54 \times 4000}{0.4\,\pi} = 2420$$

To this must be added the ampere turns to oppose the armature mmf. If the reduction of current in the short-circuited coils is neglected, the armature ampere turns per pole are

$$\frac{1}{2}\,\frac{zI_c}{p} = \frac{(120 \times 8) \times 76}{2 \times 6}$$
$$= 6080$$

If we neglect the very small mmf required to overcome the reluctance of the interpole core, the total ampere turns on each interpole should be 2420 + 6080 = 8500 at full load. The full-load current of the machine is 200,000 ÷ 440 = 455 amp, and the required number of turns is 8500 ÷ 455 = 18.7. In practice about twenty turns would be put on the interpole of this machine, and if necessary a diverter would be provided to adjust the current in accordance with results obtained on test.

Concluding Remarks

It is not suggested that the method of considering commutation phenomena as outlined above covers the subject completely. The designer aims at obtaining "ideal" commutation under certain load conditions, knowing well that, even when series-wound commutating poles are used, the required conditions cannot be exactly fulfilled at other loads. He relies on the resistance of the carbon brush to give sparkless commutation even when the conditions depart appreciably from those of "ideal" commutation. The extent to which the ideal condition can be departed from without producing destructive sparking is not easily determined except by experimental means. This point will not be discussed here, but it may be stated that the best way to approach the problem of sparking limits is to consider the amount of energy, per unit length of brush contact, which has to be dissipated at the moment the mica passes from under the brush.

Apart from all considerations of a mechanical nature, commutation can be improved by increasing the thickness of insulation between commutator bars. This might in many cases be made considerably thicker than the usual 1/32 in. with advantage in the matter of sparking; but it is not always easy to obtain large spacing between bars, and thick mica insulation is otherwise objectionable.

When calculating the equivalent slot flux, the assumption made virtually supposes the slot to contain a large number of small wires all connected in series. With solid conductors of large cross-section, the local currents in the copper would alter the distribution of the slot flux and call for a reversing field differing slightly from the field calculated by the aid of the formulas given in this article. Again, the field due to the armature mmf is usually assumed to be stationary in space. This is practically true when the number of teeth is large and the brush arc is a multiple of the bar pitch. With few teeth and a brush covering a fractional number of bars, the oscillations of the armature field (of small magnitude but high frequency) may have some slight effect on commutation; but with a better understanding of the main principles underlying commutation phenomena these and similar modifying factors of secondary importance tend to assume a less formidable aspect. In the writer's opinion, the fact that machines are now made to commutate satisfactorily without requiring an unreasonable amount of attention on the part of the operator is less the result of the many clever and commendable mathematical papers that have been written on this subject than of experience gained through innumerable failures. The designer who must of necessity be an engineer, desires to see clearly what he is doing. If he uses formulas of which he does not know the derivation or physical significance, he is working in the dark. In general, he asks for more physics and less mathematics. This article, as mentioned at the outset, has been written in the hope that it will help to elucidate some of the physical aspects of commutation phenomena.

Central Station Management

Devoted to Discussion of Administrative Policies, Commercial Methods and Current Practice Among Successful Utilities

Pittsfield Contest Brings Out 400 Slogans

In response to a contest which is being conducted by the Pittsfield (Mass.) Electric Company for a slogan which is to appear on a large electric sign the company purposes to erect, more than 400 suggestions have been sent in to the special committee appointed by the president of the Board of Trade. From the large number received, this committee has selected four slogans as follows: "Pittsfield—Active, Attractive," "Pittsfield—Heart of the Berkshires," "Our Field, Your Field, Pittsfield" and "Pittsfield, Our Town."

Citizens interested in the welfare of Pittsfield have been asked to send postal cards to the Board of Trade stating their own individual choice among the four slogans offered. Two prizes, one of $10 and one of $5, will be awarded to the persons submitting the two slogans to which first and second place are respectively awarded.

The N. E. L. A. Residence-Service Campaign

During the last three years, in answer to a widespread demand for "business-getting" booklets, the Commercial Section of the National Electric Light Association has issued, through its publications committee, eight or ten booklets with an aggregate circulation of upward of 500,000 copies.

A few months ago, however, it was realized that one of the most pressing needs of the hour among the association's member companies was a "hammer-and-tongs" residence-service campaign that would enable commercial managers to keep everlastingly after their unconnected residence "prospects" with a collection of rapid-fire publicity matter covering a period of at least one

Keep Cool
THERE is always a satisfaction in knowing that, with a trusty Electric Fan, no matter how hot or sultry the day or night, you can always be assured of a cooling breeze at the turn of a switch.
Sea Breezes at Your Command
in dining room at meal time, in the sleeping room at night, in the laundry on wash day, an Electric Fan may be readily placed in any part of the house. The cost is very little. Electric Fans may be had in a number of varieties, and

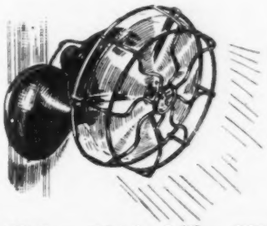
POST CARD TO BE MAILED JULY 1

year. Work was at once started on the preparation of literature for this campaign, and the first edition is now in press.

The service offered comprises thirteen separate pieces of advertising literature, including snappy, well-printed booklets, mailing folders and fac-simile letters with return cards. It is designed to cover a maximum period of twelve months, or to be mailed twice a month if necessary. Space is provided on each piece of printed matter for the imprint of the local company making use of the service. The scheme is designed to be so flexible that large companies having their own advertising departments will find that this service may be dovetailed into their existing or prospective new-business campaigns with the greatest ease and with most gratifying results. Other companies will find this residence-service campaign an effective and inexpensive solution of one of their most difficult problems.

It may be added that the material of the series has been prepared under the supervision of some of the leading advertising managers of the central-station industry—men who are experts in this particular line of work and whose concentrated craft and experience in the art of rounding up and corralling the prospective customer have been gratuitously contributed in the preparation of this campaign. Member companies of the association are offered this service at actual production cost plus a small percentage for overhead expense. Orders may be addressed to the sales manager of the Commercial Section, Mr. E. A. Edkins, 120 West Adams Street, Chicago.

How Fan Advertising Is Arranged at St. Louis



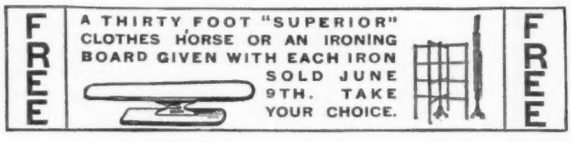
Makes 90° feel like 60°

At St. Louis, Mo., where the appliance department of the Union Electric Light & Power Company is known to have a remarkably efficient selling organization, considerable attractive electric-fan advertising has been used recently in the daily papers. One of these advertisements, which was somewhat of a departure from the usual methods, is reproduced herewith. In the upper left-hand corner of a page of the daily paper appeared the picture of a fan with the single statement "Makes 90 deg. feel like 60 deg," the advertiser's name being withheld from the copy. A reader seeing the advertisement naturally looked for the company's name and found it in the lower right-hand corner of the same page beneath the smiling figure of a big man in his office chair enjoying the cool breezes of the fan. Either advertisement alone gave the reader the idea of the advantages and comforts to be secured by the use of fans, but taken together the two separate pieces of copy told the story concisely and completely. The St. Louis company is offering fans at prices ranging from $8 to $21.40 and allows customers to pay for them in three instalments.

Selling 2402 Electric Irons in One Day at St. Louis

Beginning early in June, the Union Electric Light & Power Company, St. Louis, Mo., started a flatiron campaign by which it aims to distribute during the summer months more than 6000 electric irons in territory already well saturated with electrical appliances. A special one-day sale was launched June 9, and this was preceded by numerous but small newspaper advertisements known as "teasers," quoting such attractive phrases as "Iron electrically in hot weather," etc. With the opening of the campaign, larger space was used in the newspapers, 44,000 post cards stamped on both sides were mailed to electric-service customers, 45,000 diamond-shaped "fliers" were hung on door-knobs, lamp-posts and other convenient and conspicuous places about the city, and large readable canvas signs were attached to the sides of the company's thirty-five electric trucks.

Advertising literature on the post cards and in the papers offered the company's patrons standard 6-lb. General Electric household irons for $2.85, the payments to be made monthly as follows: first month, $0.85; second month, $1, and third month, $1. As an additional attraction, the company offered with each purchase either a folding clothes-rack having 30 ft. of drying space or a special shirt-waist board.



CARD DISTRIBUTED IN FLATIRON CAMPAIGN

As the result of its one-day sale on June 9 the company sold altogether 2402 electric irons.

How Motor-Service Business Grows at Muncie, Ind.

All but two factories operating in the city of Muncie, Ind., are now receiving electric service from the mains of the Muncie Electric Light Company. One of these factories is operating low-pressure steam turbines. All the laundries in the city with one exception are also operating on central-station energy, and an estimate of cost is at present being made up for the owner of the laundry not receiving service.

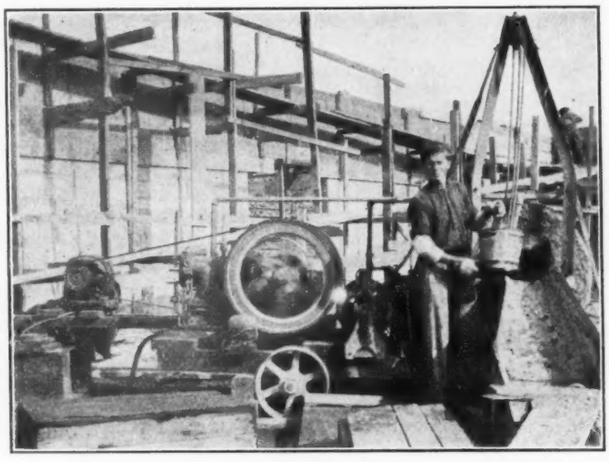
The fact that nearly all of these industrial plants are connected to the central-station company's lines does not mean that motor-service business in Muncie is nearing saturation, for it has been the experience of the new-business department that each industrial concern adds to its motor equipment from year to year, and that each sale of additional service becomes easier than the preceding one. At present the revenue from the sale of motor service in Muncie is greater than that from lighting. During the first part of 1914 the revenue for motor service alone averaged at the rate of about $4.85 per capita.

Apartment-House Owners Provide Free Fan Service

To make one of its apartment houses especially attractive and comfortable during the hot summer months, the Consolidated Realty Company, Louisville, Ky., has installed sixty electric fans. These have been distributed among the apartments according to their size. No additional charge is made for the service which will be furnished through the four summer months. At the end of that time the fans will be leased to the tenants, or will be collected and stored until next season. The fans are of the 8-in. non-oscillating type. Another high-class apartment house now being built by the same realty company will be similarly equipped with fans and also provided with beds which slide into recesses in the wall during the daytime.

An Effective Way to Operate a Gasoline Engine

Recently a motor sales engineer employed by the St. Clair County Gas & Electric Company, of Belleville, Ill., called to see a local manufacturer who had a large warehouse in course of erection. He found the owner in an almost frantic condition induced by the erratic performance of his gasoline engine, which was direct-connected to a concrete mixer. For two days this engine had defied the mechanical talent of the city, barking spasmodically and then subsiding into deep and unbroken repose. Needless to say, the enjoyment which this behavior caused the small army of laborers was not reflected in the looks or diction of their employer. He appealed to the central-station man for aid in starting the engine, with the result as shown in the picture. The engine started forty minutes later with less noise, it is true—but not to stop again without permission until the entire building was completed.



MOTOR-DRIVEN CONCRETE MIXER AT BELLEVILLE, ILL.

The Building Structure for the Home Garage

The construction and architecture of the building to house the electric automobile kept on the owner's premises were discussed before the Washington Section of the Electric Vehicle Association recently by Mr. H. B. Hart, of the Potomac Electric Power Company. The structure selected may vary from that of a size just able to house the car and charging equipment to one of liberal convenience and possibly even spare capacity for a second car. The architecture will be governed, of course, by the amount of money to be spent and the design of the home building and the space available. Such garages may cost as much as $2,000, although, on the other hand, a plain sheet-metal building can be erected for $100 to $200. Similar brick construction would cost perhaps $400

In considering the plans for a garage, stated Mr.

Hart, owners should not overlook the fact that the expenditure of a little extra money for conveniences may add much to the usefulness of the garage. Plenty of light should be provided and several outlets should be arranged for extension lamps to aid in inspection. A floor sloping to a drain is a great convenience where the car is washed in the garage. Provision should also be made for heating the garage in winter, so that the temperature of the battery may be kept close to normal even in extremely cold weather. In small garages this can often be economically and conveniently accomplished by small electric heaters, provided the structure is well built.

Besides the usual minor tool equipment for making incidental repairs and adjustments, the owners should not fail to provide a workbench with a vise and an assortment of wrenches and miscellaneous tools. There should also be jacks to lift the wheels when replacing damaged tires or adjusting and testing brakes. When the car is to be laid up for a month or so the jacks prove useful in relieving the pneumatic tires of their load. With the car on the jacks one can also measure the energy required to see that the mechanism operates freely. Tires should be pumped by gage and the pressure checked at least once a week. By all means, added Mr. Hart, have at least one fire extinguisher and provide a small metal locker in which to keep oil, grease, polish, rags, spare parts or lamps, fuses, tires, hydrometer, thermometer, a pitcher for distilled water, etc.

"Free Electricity" with Each Appliance

At the time of the recent "electrical show" given by the electrical interests of Shreveport, La., the local central-station company presented to the purchaser of each energy-consuming device bought from one of the exhibitors a credit memorandum good for from 50 cents to $3.50 in the payment of the customer's electricity bills. The size of the allowance was based on a schedule of 50 cents for every 50 watts of demand of the appliance purchased, but no memorandum was issued for an amount greater than that above named. Thus, a customer who paid the special price of $2 for a 500-watt electric iron received in addition a credit slip for $3.50, equivalent to the cost of about 40 kw-hr. at the Shreveport rate of 8.5 cents per kw-hr. This credit slip was not good, of course, for the payment of minimum bills.

During the electrical show nearly 600 irons were sold by the contractors and dealers who made exhibits.

Good for $..... worth of Electricity.

Present to Cashier with your monthly Lighting or Power Bill.

Not good in payment of minimum bills.

SOUTHWESTERN GAS & ELECTRIC CO.

CREDIT SLIP USED AT SHREVEPORT, LA.

In Shreveport the average revenue from a 500-watt electric iron is said to be about $1 per month with energy at 8.5 cents per kw-hr., and although the "free electricity" tickets cost the company a good deal the first few months, it is believed that the new business secured through the use of the plan will make the investment a profitable one in the future.

Handling the Customer with a Complaint

"When a customer calls in person to make a complaint, much diplomacy is required," said Mr. F. R. Slater in a discussion of public policy of utility corporations before the recent Southwestern electrical convention at Galveston, Tex.

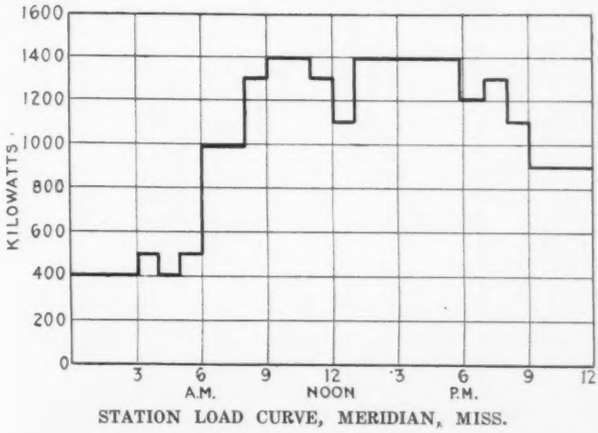
"Such a complaining customer has usually come at some personal inconvenience, and not infrequently has recited to himself so many times his grievance, real or fancied, that he is on the point of exploding when he gets to your office. Listen to his troubles patiently and try to take his viewpoint; you will frequently find that his grievance is trivial and can be readily adjusted without any real trouble on your part. If a complaining patron can be pacified, and at the same time be shown that an endeavor is being made to remedy the situation he has brought to your attention, he is likely to prove a mighty live friend of the company ever after. Much adverse public sentiment with which corporations have to contend could be dissipated if systematic attention were paid to the troubles which individual patrons have on their minds.

"Show appreciation of every service rendered by your patron. If he calls your attention to some fault or weakness in your service—thank him. If he makes a suggestion for the betterment of the service—thank him. If he gives you an order to furnish him your service—thank him. If he pays his bill—thank him. In short, for every service rendered, no matter how trivial, say 'Thank you,' and say it because you mean it."

Daylight Peak Caused by Motor Load at Meridian, Miss.

Unusual load conditions prevail on the system of the Meridian (Miss.) Light & Railway Company, where owing to the large rating in motors connected the demand during daylight hours often exceeds that during the lighting peak. The Meridian company at present has a motor load aggregating 2800 hp, which is divided up among 275 motors. Its total connected load including both lighting service and motor service amounts to 5700 hp.

Below is the load curve of the Meridian steam-turbine station, whose output also includes 5000-volt direct current furnished through rotary converters for the street railway. As revealed by the sketch, the load during the hours of the day is actually greater than the lighting peak which comes between 6 and 9 o'clock p. m. The curve reproduced herewith indicates a load-factor of nearly 70 per cent.



STATION LOAD CURVE, MERIDIAN, MISS.

Illumination and Wiring

Arrangement of Primary and Secondary Lines on Cross-Arms

To afford as much protection as possible to its linemen when they are working on poles, the Public Service Electric Company of New Jersey uses the following construction on its overhead city lines where energy is distributed from the substations over 2400-volt single-phase circuits. The primary conductors are supported on insulators at the outer ends of the top cross-arms well out of reach of men on the pole, while the secondary circuits fed from pole transformers are arranged on a lower cross-arm or else on each side of the pole head on the upper cross-arm. Series street-lighting circuits are also placed as far out on the cross-arms as possible to prevent linemen from coming in accidental contact with them.

An Elaborate Spectacular Sign at Chicago

The large "Do It Electrically" sign which has been in operation for some time on the Harrison Street station of the Commonwealth Edison Company has recently had added to it a spectacular flashing portion. This addition represents the forging of a hot steel bar under a converted steam hammer, the steam power having been superseded by compressed air pumped by an electric motor using central-station energy.

Two machine attendants are represented, one operating the control lever and the other forming the steel bar. The latter is seen to place the white-hot bar beneath the hammer, and at each blow sparks flash out realistically, decreasing in quantity as the iron cools. By outlining the connecting rod with a double circuit of amber and ruby lamps the bar is made gradually to lose its "white-hot" color and to assume a "cherry-red" heat as the hammering continues and the rod cools. The portion of the rod held in and adjacent to the hands of the workman is illuminated with amber-colored lamps to represent a lesser degree of heat.

The movements of the other workman are particularly realistic. With his hand on the throttle he moves it slightly once or twice, to make sure the hammer is operating correctly. Then he throws the valve wide open and allows the hammer to strike with its full blow.

Color effects are secured by using colored-glass tips, which are fastened to the bulbs by means of small springs. Green hoods are employed to outline the machinery, opal hoods for the hammer head and men, and ruby and amber tips for the steel bar and sparks.

Installed in the entire sign are 3617 10-watt tungsten lamps, 1600 of which are in the flashing portion. The total connected load is about 50 hp. Energy is supplied to the sockets of the new addition at 11 volts, being reduced to this pressure by a 10-kw transformer installed near the sign.

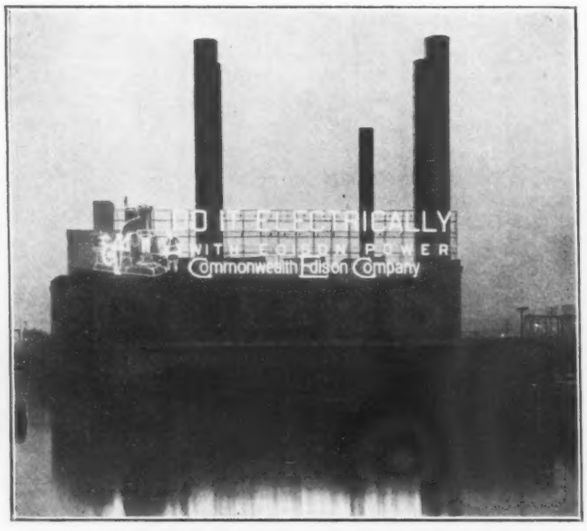
The total length of the display is 204 ft. and the height 42 ft., the flashing portion being 55 ft. wide. The magnitude of the sign is indicated by the height of the machine attendants, who are 36 ft. tall.

Ten seconds is required for a complete operation of the sign, the bar being on the anvil eight seconds. The sign was manufactured by the Federal Sign System (Electric), Chicago, and the flasher was built by the Reynolds Electric Flasher Company, Chicago.

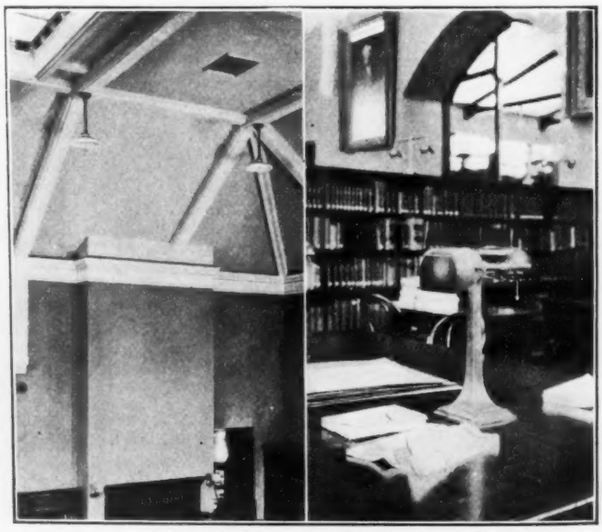
Modernizing the Lighting of a Public Library

In connection with the recent remodeling of the Newton (Mass.) Free Public Library the interior electric-lighting installation has been thoroughly overhauled and the institution has now become one of the best illuminated buildings of its kind in New England. The principal engineering details of the improved installation are illustrated in the accompanying photographs. Typical equipments are described in relation to the various classes of lighting service required in the building. Energy for the library circuits is furnished by the local lines of the Edison Electric Illuminating Company of Boston.

Fig. 1 shows the general method of lighting the interior of the main reading and reference rooms, the view having been taken from a platform at one end on account of the high studding of the ceiling. This room is sectionalized by low shelves for reading and reference works, with a central aisle running from the vestibule to the delivery room, which is at the rear and between the reading rooms and stackrooms. It is about 58 ft. long by 35 ft. wide, the lamps being approximately 35 ft. above the floor. They are arranged in two rows



ELECTRIC SIGN ON HARRISON STREET STATION OF COMMONWEALTH EDISON COMPANY



FIGS. 1 AND 2—LIGHTING SCHEME, READING AND REFERENCE ROOMS, AND TABLE FIXTURE

spaced 20 ft. apart, the individual lamps being about 8.5 ft. apart in each row. Eight 250-watt tungsten units with prismatic glass reflectors are provided to give an effective general illumination, the individual tables being equipped with two-lamp standards, as shown in Fig. 2.

The typical reading-room table standard is of dull-finished brass, carrying two parabolic porcelain shades, in each of which is mounted a 20-cp lamp on a horizontal axis. The outsides of these shades are tinted green, the inside surfaces being finished in white. The shades are adjustable through an angle of about 330 deg., so that glare can be prevented for readers of every height. The standards are 7 in. square at the bottom and the lamp axes are 16 in. above the table surface, the shades being each 9 in. long and 4½ in. wide. Pull chains are provided at diagonally opposite corners of the fixture, and energy is supplied by a flexible metal conduit carried upward from the floor through the table and up the inside of the standard to the lamps. In the reading room the standard table is 10 ft. long and 4 ft. wide, the lamps being set with the center of the fixture 30 in. in from the edge, making the fixtures 5 ft. apart measured between centers. For the reference room the tables are 8 ft. long by 5 ft. wide, and each is provided with two fixtures holding two lamps each, the fixtures being each 2 ft. from the nearest edge and 4 ft. apart on centers.

Between the main aisle of the library and the reference room is a partition, having on one side shelves carrying books frequently consulted and on the other side photographic displays. The method of lighting these books and the photographic exhibitions is shown in Fig. 3. A typical case is 13 in. wide and about 6 ft. high, its length being 14 ft. Such a section is illuminated by six 20-cp lamps installed in pairs 18 in. apart laterally and 5 ft. apart longitudinally, associated lamps being hung from horizontal brass rods and surrounded by green and white porcelain bell-shaped shades 6 in. in diameter. Three 20-cp lamps, added to the ceiling equipment, suffice for the convenient use of the reference shelves and illuminate the exhibits on the opposite side of the case with entire success. The lamps are carried about 6.5 ft. above the floor, and the supporting rods are 13 in. high above the mahogany case.

Fig. 4 illustrates the local lighting of the delivery desk, which is 14.5 ft. long and 10 ft. wide, with a counter 39 in. high above the floor and 28 in. in width. At the front of the desk are two 20-cp lamps carried in standard reading-room shades at a height of 14 in. above the counter plane and set about 4 ft. apart. Two double 20-cp units set about 7.5 ft. apart are placed at

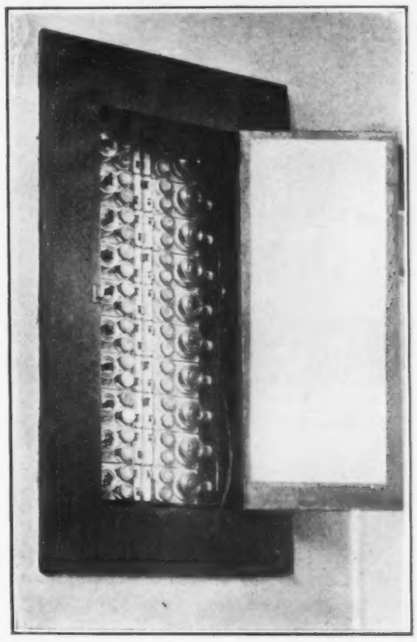


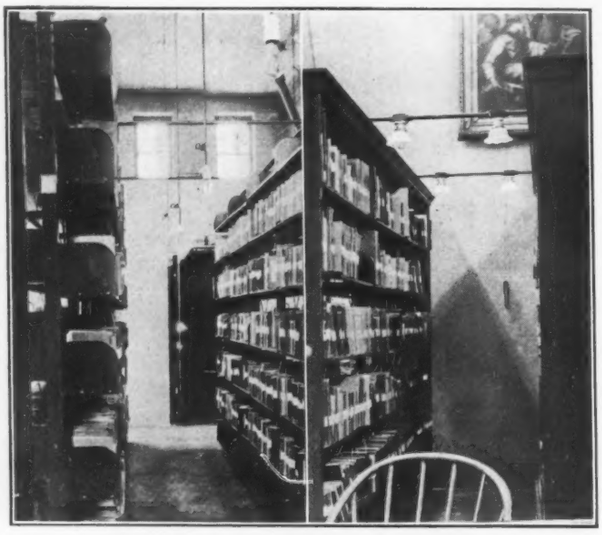
FIG. 5—SWITCH AND FUSE CABINET, DELIVERY ROOM

the rear of the delivery counter, and the room is provided with excellent general illumination from twelve 100-watt lamps carried around the central rectangle at the roof-truss level. Adjacent to the delivery desk is a switch and fuse cabinet, illustrated in Fig. 5, controlling the local circuits in the reading and delivery room.

The card catalog, adjacent to the delivery desk, shares in the general illumination of the room, but is chiefly lighted by 20-cp lamps inclosed in sand-blasted-glass, bell-shaped shades, 7 in. in diameter and 5 in. deep, supported by brass rods 18 in. long and hung 25 in. above the top of the catalog case. The latter is of the "Library Bureau" type, with sixty drawers per sec-

FIGS. 3 AND 4—LIGHTING REFERENCE-BOOK SHELVES AND PHOTOGRAPH EXHIBITS, AND DELIVERY-DESK UNITS

FIGS. 6 AND 7—LIGHTING OF CARD CATALOG AND NEW-BOOK STACK



FIGS. 8 AND 9—LIGHTING OF MUSIC STACK AND MAIN STACKS

tion, a group of three sections being about 4 ft. long, 40 in. high and installed with the bottom 20 in. above the floor. One 20-cp lamp cares for the lighting of sixty card drawers, the lamp tip being installed vertically above the edge of the case, which is 18 in. wide. Fig. 6 illustrates a typical card-catalog-lighting section.

The new-book stack (Fig. 7) is composed of sets of shelves 18 in. wide and about 7.5 ft. high, a section 9.5 ft. long, parallel to the shelves, being illuminated by two 40-watt tungsten lamps carried by condulet outlets attached to pipe conduit run along the tops of the shelves, as shown in Fig. 8. The lamps are spaced 4 ft. 8 in. apart in front of the shelves and are carried about 12 in. out from the shelf in each case. The neighboring sets of shelves are about 5 ft. apart, and it is found unnecessary to light more than alternate lamps between each stack, the amount of light being sufficient from two units beneath each group of shelves.

Fig. 8 represents the lighting of the music stack, the shelf units of which are 35 in. apart horizontally, served by four outlets per intermediate section, the conduit lines being 4 ft. 9 in. apart. In the present location of this stack a single 25-watt lamp between each set of shelves is sufficient on account of the general lighting available from above.

Fig. 9 shows the lighting provided for the main stacks behind the delivery room, each lamp being controlled by a separate key switch in its socket. The usual units are bare 20-cp lamps, these being hung 6 ft. above the floor and from 5.5 to 7.5 ft. apart. Three units handle the service of a 15-ft. stack, whose shelves, five in number per tier, are 18 in. wide and spaced 4 ft. 3 in. apart. These lamps are used mainly in intermittent service and are suspended by lamp cords from ceiling outlets.

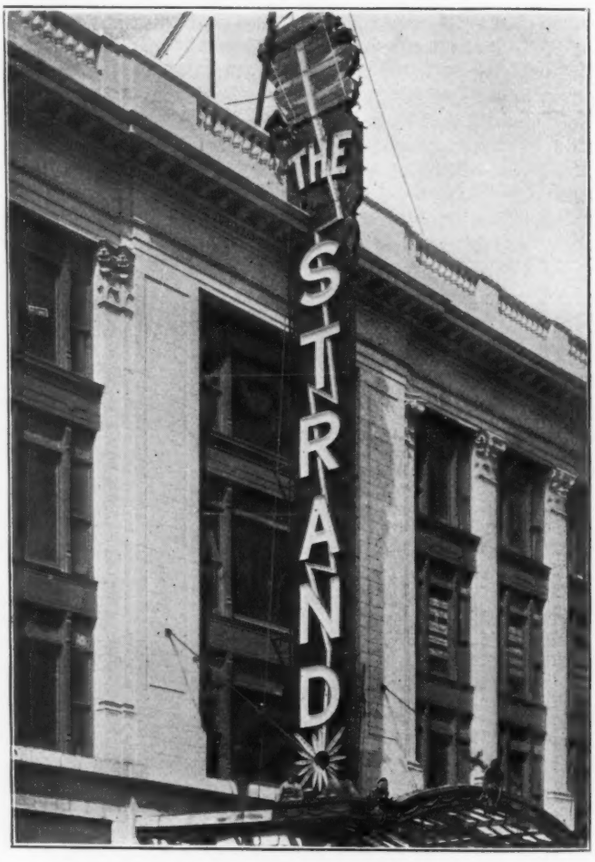
Emergency Cabinet for Line Department

To prevent its linemen from rushing out on dark, stormy nights to re-establish service when they are only partly equipped for the work, the Wichita Falls (Tex.) Electric Company has provided its line department with an emergency cabinet. In this case are kept gloves, spurs, body belts, raincoats, boots, fuse boxes, fuse wires, pliers, hand axes, screwdrivers, hand lines, ropes, lanterns, searchlamps, matches, etc. The searchlamp is particularly useful, being mounted on a tripod so that it can be swung in all directions and flashed on the pole tops for inspection or to facilitate night construction or repair work.

Sign Representing Lightning Stroke and Producing Crash

In front of the new Strand Theater, New York, is an electric sign designed to attract attention to the name of the theater which represents a lightning stroke from some artificial clouds to earth and produces a blue flash and a crash as the lightning strikes. The clouds are very ingeniously constructed so as not to display their source of illumination and to represent sheet lightning prior to the direct stroke. The clouds consists of horizontal metal strips arranged like a louver so that the light from within is diffused over the visible portion of the vanes, which are painted to represent clouds. By causing the light to flicker a semblance of sheet lightning is produced, after which a zigzag stroke darts downward along the sign, terminating with a flash and a crash from the discharge of high-potential energy across a gap. The high-potential discharge is caused by an oscillator similar to that used in wireless-telegraph work. The coil is installed within the building, and the terminals are led out through insulated bushings to the discharge points. While the lightning stroke is spectacular, the noise accompanying the discharge at the gap is decidedly more so and is very effective in attracting the attention of passers-by who are not in the habit of observing illuminating effects.

The sign and flasher were constructed in the factory owned by Mr. Mortimer Norden, New York.



SIGN REPRESENTING LIGHTNING STROKE

Recent Telephone Patents

The transmitter patented by Mr. H. E. Shreeve, of Millburn, N. J., is intended for use with heavy currents as for loud-speaking circuits, and is designed with particular view to the dissipation of heat. The rear part of the instrument is a large circular block of metal carrying deep grooves to increase its radiating surface. The rear electrode is mounted on the front face of this block at its center, and an annular groove in the metal surrounds the electrode. In this groove there rests a ring of catlinite which projects sufficiently to form the side walls of the granule box. A thick plate of metal similarly grooved carries the front electrode and provides a seat for the front end of the catlinite ring. The movable electrode lies midway within the chamber and is mounted upon a stud which fuses through an insulated stuffing box of the front electrode. No casing of the usual sort is provided, but a face plate carrying the mouthpiece and forming a seat for the diaphragm is arranged over the front plate. The patent is assigned to the Western Electric Company.

Antiseptic Device

Antiseptic devices still attract the effort of inventors. Of two patents bearing on this subject recently issued, one, granted to Messrs. E. M. Doeringer and A. C. St. Marie, of San Francisco, Cal., describes a device in the form of a hollow sheet metal cone which fits the base of a mouthpiece, being inserted from the front. It is filled with antiseptic fiber and has lugs which so maintain its position that space is left for passage of sound.

The intercommunication feature of the circuit system patented by Mr. William Aitken, of Liverpool, England, relates to a main line and an extension station upon an exchange line. The main-line station can signal and talk with the extension or can extend the exchange line to the extension. The novelty lies in arranging an electromagnetic trip so that after a conversation involving the extension the keys at the main station are automatically restored to normal.

Testing Circuit

Mr. H. M. Friendly, of Portland, Ore., has patented a method of testing conductors especially designed for wire chiefs' use. Here the idea has been to eliminate calculation as far as possible in the location of faults by the loop test. The special instrument consists of a voltmeter the moving coil of which is tapped at its middle. The high series resistance is in two portions with the coil in the middle, one portion being adjustable by an arm and dial. If the battery be connected from the ground to the middle terminal of the voltmeter, and the two ends of the coil be connected to the two wires of a faulty conductor having the distant ends strapped together, the voltmeter may be adjusted to zero by the variable series resistance. Zero reading will indicate equal current, and therefore equal resistance, in each side of the voltmeter, and the amount of series resistance cut out will equal the resistance of the conductor beyond the fault. There are other similar methods of use for this apparatus.

New Apparatus

Mr. G. H. Nash, Highbury, London, England, has patented a relay cap and assigned his rights therein to the Western Electric Company. The novelty of this device lies in the mode of attaching the cap to the relay. Inwardly projecting radial lugs stamped in the cylindrical case engage with similarly formed spiral grooves in the cap mounting and hold the two pieces firmly together. When attaching the cap to the relay the lugs and groove are registered and the cover twisted slightly about its axis.

Letters to the Editors

Power-Bond Election in Los Angeles

To the Editors of the Electrical World:

SIRS:—In the May 30 issue of the *Electrical World* there is a letter from Mr. E. F. Scattergood, chief electrical engineer for the Bureau of Los Angeles Aqueduct Power, taking exception to my criticism regarding the estimated cost of distribution for the city of Los Angeles. Mr. Scattergood backs his estimate by the statement of the three independent engineers employed by the city to check it.

The differences in the estimates are mainly due to the fact that both Mr. Scattergood and the three engineers mentioned have figured on a hypothetical case, assuming that there is no existing distributing system in the city of Los Angeles and omitting consideration of the fact that the inhabitants thereof have invested hundreds of thousands of dollars in apparatus. For instance, there is a great difference between estimates on the underground system. The existing companies furnish three-wire direct current at 110/220 volts to practically every modern office building, as the baseboards of these offices are equipped with appliances for using direct current at that potential. Furthermore, most of the modern office buildings going up in Los Angeles are being equipped with 220-volt modern traction elevators. These elevators are designed to operate on 220-volt direct-current energy only. Also, every newspaper published in the city of Los Angeles, with the exception of one, uses 110-volt or 220-volt direct-current energy. To supply this service means a very large capital investment in substations, motor-generator sets, heavy copper feeders, and, in the case of the Southern California Edison Company, a large storage-battery auxiliary.

Apparently the policy of the city of Los Angeles as expressed through its engineers, Mr. Scattergood and his assistants, is that the three-wire direct-current system is obsolete; that the people can use alternating-current elevators, if they need elevators; that they can scrap thousands of dollars' worth of small direct-current motors and purchase the alternating-current type, and that, in fact, the people should take what the city gives them and be thankful. This one item of difference in the cost of furnishing alternating and direct current is the cause of a great deal of discrepancy in the estimates.

Under the state law, the public-utility companies are required to use an equivalent of No. 4-0 conductors, or twice the size of the main conductors, for all potentials over 15,000 volts wherever the lines pass over any telephone, telegraph or other wires of lower potential. Mr. Scattergood in his estimate did not figure on this size of conductor; perhaps the city is above the law. The State also compels public-utility companies to use a certain amount of clearance between conductors, the companies being required to use poles at least 45 ft. in height for most of their work. From Mr. Scattergood's estimate of cost of poles, the city cannot possibly purchase poles of this size for the amount given. The estimate made by the three engineers was based on fast-closed lines, according to their instructions, and they were not taken from the service now existing, but given as the solution of a hypothetical case. They also know, as does Mr. Scattergood, that the amount voted on at the recent election cannot possibly duplicate the present distributing systems of the city of Los Angeles and give the people the service they require and have been receiving from private companies.

The aqueduct engineers make no provision for steam-plant reserve. During the severe storms of last winter, when transmission lines, bridges and roadways were washed out throughout southern California, the city service, had it been in existence, would have been out of commission for many weeks. Although the Edison transmission lines were washed out, still service to customers was not interrupted for more than one hour, owing to the presence of the large steam auxiliary plants always in commission.

J. A. Lighthipe,
Electrical Engineer Southern California Edison Company.
Los Angeles, Cal.

Power-Bond Election in Los Angeles

To the Editors of the Electrical World:

Sirs:—Referring to the communication of Mr. E. F. Scattergood in your issue of May 30, in which he takes issue with Mr. J. A. Lighthipe over the latter's contention that "the plant of the city cannot be finished for the amount estimated," the writer has made an independent investigation covering this phase of the Los Angeles problem and has reached conclusions which are at variance with the results to be inferred from the report of Prof. C. L. Cory, Dr. George L. Hoxie and Mr. C. W. Koiner.

It is useless, in a consideration of engineering data, to introduce "suppositions contrary to fact," and it is to be regretted that the political exigencies of this case demanded the presentation to the engineers of certain hypothetical questions which would yield to a reasonable degree the answer desired by the city.

A correct analysis of the possibilities of condemning a portion of the system of the Southern California Edison Company presents more than the mere assumption of control of a system already established, with or without the consent of the party owning the property to be condemned. To the cost of this portion of the Edison company's system must be added the damage sustained by the severance of a considerable portion of an interconnected system, such as that of the Southern California Edison Company. In addition to this, the city will have to obtain the consent of every public-service company in Los Angeles to acquire the Edison company's rights on any jointly owned pole. The legal phases of the problem present difficulties which will lead to the early abandonment of the scheme or to the deferring of the distribution of aqueduct power for many years to come. We must, therefore, consider the city as an incoming competitor, with $5,250,000 available for the construction of a complete distributing system.

The first step taken by the incoming company (rates being equal) should be to render the consumers the same service now given by existing companies. What is the policy as proposed by the city? An examination of the engineers' report displays the rather startling anomaly of ignoring entirely the demands of a large class of consumers operating motors who desire to use 110-volt and 220-volt direct-current energy, now adequately delivered over a system representing an investment of almost $1,000,000. Such policy on the part of the city prohibits its getting any but a small portion of either the alternating-current or direct-current load in the commercial districts. The city will, therefore, find itself under the necessity of taking only the business of the small lighting consumer, the citizen who believes he is to get something for nothing in securing municipal service. The recent bond election furnished ample evidence that these citizens are fairly uniformly distributed throughout the entire city, making a complete distributing system imperative from a competitor's standpoint. All business, however small, that is available must be obtained, even though much of it must be operated at a loss and at a very poor load-factor.

With reference to construction costs on a distributing system in Los Angeles under present conditions, it should be noted that a competing company entering the field is confronted with a comprehensive system of jointly owned poles. Notwithstanding that many streets have been left free and open to a competitor, the item of crossing clearances, as demanded by the regulations of the Railroad Commission, and statute requirements governing overhead construction, render the installation of an additional system impracticable and expensive.

Even from a theoretical standpoint, a distributing system, as proposed by the city, cannot be erected for the amount named in the engineers' estimates, even under the assumption that 40-ft. poles are used throughout. The average pole which the city will be compelled to set will be about 50 ft. in length. The cost of obtaining proper clearance to comply with existing regulations will amount to more than other labor costs on the city's lines. The figures submitted by the engineers represent restricted and ideal conditions which are not found to exist.

However, when the time comes and excuses are required, we may be able to quote reasons similar to that presented in the twelfth annual report of the Bureau of Public Service Commission relating to the dissipation of the former bond issue of $3,500,000. This report offers such interesting reading that I quote it herewith, in part: "The estimates, however, were greatly exceeded, partly because the final designs were changed in order to increase both the amount and the reliability of the power to be developed, but mostly because a great deal of rock, through which tunnels were driven, was found to be very bad, rendering the tunnel work much more expensive than was estimated."

Professor Cory, Dr. Hoxie and Mr. Koiner should certainly know, as Mr. Lighthipe knows, that the city system will not be installed for any figure approximating that represented by the bond issue. No criticism is intended reflecting upon these or the other eminent engineers who were called upon to answer certain hypothetical questions, except in so far as any of them had a part in the framing of these questions. The instructions issued to these engineers limited their examination and report to a consideration of:

(a) The cost of installing a distributing system such as would be appropriate for taking care of all electrical service within the city, exclusive of railways. (This is a theoretical consideration, not capable of even approximate realization and, taken in connection with the omissions previously noted, is without value.)

(b) The annual cost of operation of such a distributing system. (This is immaterial for assumptions given before.)

(c) An estimate of the annual income which the city would derive from the operation of such distributing system.

The absurdity of the conclusions which the engineers were compelled to present as prescribed in (c) is excelled only by the crudity of the idea of seeking practical advice on a purely academic question.

In view of the foregoing considerations, it will probably be well to await developments, when the statement of Mr. Lighthipe will have been proved eminently correct.

Los Angeles, Cal. J. E. Macdonald.

Field of the Operating Engineer

A Record of Practice, Experience, New Ideas and Interesting Problems—Notes on Practical Subjects—Questions and Answers

Boiler Brickwork and High CO_2 Ratios

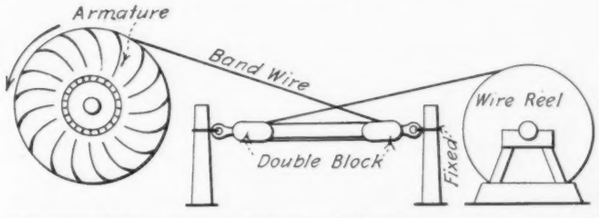
While the limiting theoretical CO_2 content in flue gases is 18 per cent to 20 per cent, it is not advisable to carry the proportion above 12 per cent to 15 per cent in actual boiler operation, on account of the high temperature to which the firebrick will be thereby subjected. At ratios above 15 per cent combustion may be so intense that the brick becomes white-hot and cannot withstand such high temperatures for more than a short time. One Southern plant operator recently made the experiment of running his CO_2 content at 18 per cent one night. For the benefit of engineers who have tried the same experiment it will be hardly necessary to add that he rebuilt his furnaces next day!

The Leaky Roof and the Leaky Steam Pipe

In the smaller electric-light plants of the country many an engineer spends a part or all of his Sunday repacking a leaky joint in some steam main which is "always giving trouble." Some of these chronic leaks may be traced to specific causes, and removal of the cause will prevent their recurrence. Perhaps the most unsuspected and least apparent of these causes is found in a roof leak above the pipe. On a rainy day water drips through the hole in a tiny stream, cooling the top of the pipe as it strikes. The resulting uneven expansion brings about a leaky joint or a blown-out gasket. Repairing the leak in the roof is generally easier than fixing the gasket and is surely more effective.

Banding Armatures with Sheave Blocks

In banding armatures the band wire should be applied with a uniform steady tension under the close control of the operator. The accompanying sketch shows a method of using a four-pulley arrangement of sheave blocks to apply this tension. The scheme illustrated was improvised "on the job" in a plant where

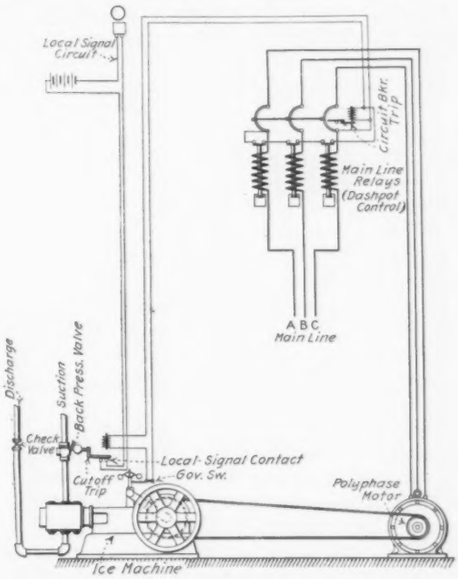


ARRANGEMENT FOR BANDING ARMATURES WITH SHEAVE BLOCKS

the usual equipment for banding was not available, and it at once proved entirely successful, band wire as large as No. 12 gage being handled with ease. By varying the tension of the wire as it is paid off the reel the friction of the pulleys can be adjusted to give the required tension in the wire going onto the armature.

An Electrical Remedy for Ice-Plant Troubles

Mr. Nels Joleen, of the Commonwealth Edison Company, Chicago, has recently perfected a wiring scheme for remedying operating troubles in motor-driven ice plants. One of the sources of trouble in the past has been the failure of a fuse in one phase of the three-



CONNECTIONS FOR REDUCING ICE-PLANT TROUBLES

phase motor circuit, allowing the motor to operate as a single-phase unit until either the motor windings or the control apparatus has burned out. To eliminate this trouble, a main-line relay was inserted in each phase and three pairs of contacts were arranged in series so that the interruption of any phase actuates the main circuit-breaker trip, opening all three phases. At first it was thought that the three-phase circuit-breaker would open with the failure of any one phase, but experience seems to indicate that relays are necessary.

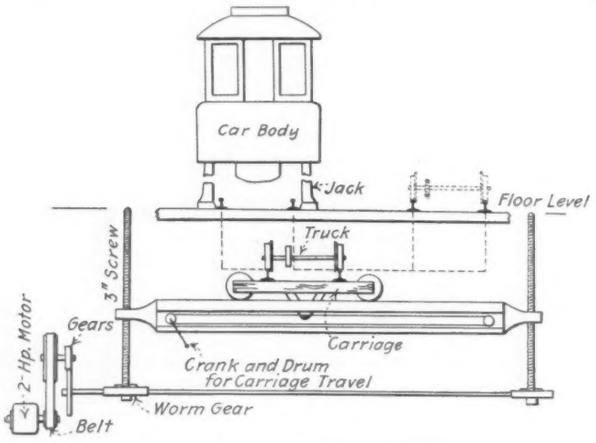
In multiple with the same circuit-breaker trip coil is another circuit which controls the compressor suction valve and is also connected in series with the contact points of a governor switch. When any phase of the feeder circuit fails the small coil above the cut-off trip is de-energized and drops its armature, accomplishing two results. First, it closes the suction line to the ice machine, taking the majority of the load from the compressor and motor. Second, it closes a local signal circuit, ringing a bell to inform the attendant that the valve in the suction line has been closed. This valve must be opened manually after the plant has resumed operation.

In case the compressor becomes overloaded to such an extent as to cause a serious reduction in speed the governor switch shown above the compressor interrupts the trip-coil circuit. This action takes the load off the compressor by closing the suction-line valve. The

alarm bell at the same time notifies the attendant of the trouble. This wiring scheme, with slight variations to suit local conditions, has been in operation in a number of large Chicago ice plants for several months, and it has been instrumental in reducing operating troubles. Reductions in maximum-demand readings have been also effected by the action of the compressor governor switch.

Motor-Driven Transfer Table for Car Shop

With the motor-driven rising and falling transfer table shown in the accompanying sketch one man can remove and replace a car truck in an hour's time, according to Mr. I. H. McArthur, superintendent of the Meridian (Miss.) street-railway system. Mr. McArthur improvised this apparatus out of old rails and spare parts and has found it extremely useful.



ARRANGEMENT OF MOTOR-DRIVEN TRANSFER TABLE

The transfer table is mounted in a concrete-lined repair pit and its movable carriage carries a 5-ft. section of the track. The car truck to be removed is run onto this depressible section and the car body supported by jacks. The 2-hp motor is then set in motion to operate the 3-in. main screws through belt and worm-gear connections, thus lowering the entire carriage with the truck in place on its rails. When the carriage is depressed enough to clear all parts, it is run across on its own transverse rails and is then again raised to floor level at the side of the car, so that the truck can be inspected, repaired or replaced. The use of double worm gears enables the platform to support a 1200-lb. load in any position without drifting. The belt provides a safety member which will slip in the event of improper operation of the transfer table.

The Purchase of Power-Plant Lubricants

In a paper on "Lubrication" presented before the Mississippi Electric Association at Meridian, Miss., Mr. R. L. Ellis, who is superintendent of the Selma (Ala.) Lighting Company and president of the Alabama Electrical Association, gave some pointed advice on the selection and purchase of lubricants. In general, said the speaker, friction is of two kinds, that due to attrition between the bearing surfaces and that within the lubricant itself. To reduce the latter internal friction to its minimum the lubricant selected should be the lightest oil which will hold the surfaces apart. Viscosity is a function of the temperature of the lubricant, $T \times V^n$ being a constant. Plotted on logarithmic paper, this relation becomes a straight line with the exponent n representing the angle of slope.

In the selection of lubricants, Mr. Ellis urged that the purchaser himself take the responsibility of applying common-sense principles to the problem instead of relying on the judgment of so-called "experts" whose own opinions could only be guesses based on the same principles but invariably requiring experimental confirmation also. Mr. Ellis said he recently submitted a detailed report of his oil requirements to four lubricant manufacturers, and that the only point on which they all agreed was that "the conditions described were unusually severe and would require the use of special high-grade oils." After visits from the experts of the four companies Mr. Ellis did not feel reassured by their disagreement among themselves, so he ordered for experimental use samples of all the oils recommended by each and some fifty other oils besides. These were tested in service and analyzed both chemically and physically until a satisfactory inexpensive lubricant was discovered for each purpose. In many cases the only difference found between the oils was in their cost to the purchaser. High prices, declared the speaker, are often attributable chiefly to psychology and salesmanship rather than to inherent differences of quality.

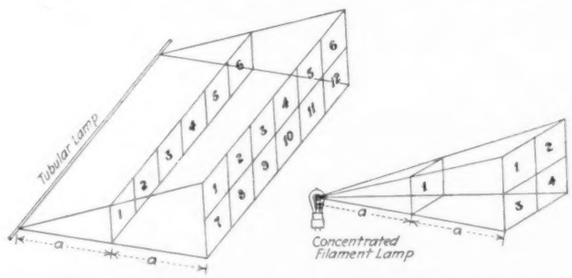
"Burn into the memory of every employee of your company," said Mr. Ellis, "that there is necessarily no relation between price and quality, or, as Henry Ford has put it: 'None but a snob or a fool confuses economy with cheapness.'"

As the result of his investigation into lubrication Mr. Ellis said he has reduced the cost of his cylinder oil to 20 cents a gallon and other oils to 14 cents. His car lubrication cost now averages 19 cents per 1000 car miles. His total oil bill at the plant, which has a monthly output of 200,000 kw-hr., is $15 a month, or 0.0075 cent per kw-hr.

Law of Inverse Squares and Tubular Light Sources

How does the law of inverse squares apply when a surface is illuminated by a source of light having considerable length?
W. E. R.

While the familiar law of inverse squares holds for the intensity of illumination surrounding a point light source, it must be remembered that different conditions exist when the light source has considerable area or length. The light flux from a tubular or straight-filament lamp to the surface illuminated thereby may be considered as forming a solid wedge, therefore the intensity is inversely proportional to the distance from the line source of light. The accompanying drawings illustrate diagrammatically how the intensity varies with point and line sources of light.



GRAPHICAL REPRESENTATION OF LIGHT FLUX FROM POINT AND LINE SOURCES OF LIGHT

Digest of Current Electrical Literature

Abstracts of Important Original Articles Appearing in the Periodical Electrical Press of the World

Generators, Motors and Transformers

Air-Blast Cooling of Transformers.—F. J. TEAGO.—A long illustrated abstract of a paper read before the Manchester Section of the (British) Institution of Electrical Engineers on experiments which were made on a 12-kva core-type transformer in order to obtain accurate information concerning the relation between the "heat rating" and the quantity and condition of the cooling air. The chief results are as follows: The temperature rise of the transformer is independent of the temperature of the inlet air within ordinary limits, provided that the surfaces to which the heat is radiated—that is, the walls, etc., of the room—are at the air temperature. Variations in the barometric pressure only affect the temperature rise to a small extent, and the correction is negligible for the small variations in the barometric pressure from day to day. The humidity of the air, up to the point of saturation, has no appreciable effect on the temperature rise. Some experiments were also made with a "fogged" atmosphere produced by atomizing water at the inlet to the transformers. The results justify the serious consideration of a "fogged" atmosphere as a cooling medium for electrical machinery, especially where the electrical pressure is only moderately high.—London *Electrician*, June 5, 1914.

Three-Phase Synchronous Machine.—T. F. WALL.—An article illustrated by diagrams in which the author deals with the development of the circle diagram for a three-phase synchronous machine and compares some experimental results with those obtained theoretically.—London *Electrician*, June 5, 1914.

Lamps and Lighting

Rating of Incandescent Lamps.—H. LUX.—A special committee of the German Illuminating Engineering Society has recently recommended that a lamp should be rated according to mean hemispherical candle-power J_o, or according to the mean lower hemispherical candle-power J_u, or according to the mean horizontal candle-power J_h. In ratings of lamps it must be exactly stated which of these three candle-powers is meant. From a purely physical standpoint the mean spherical candle-power is of most value, but for practical reasons it would often be inconvenient to discontinue the present rating by horizontal or lower hemispherical candle-powers. The committee recommended that there be stated in all such cases the conversion factor by which the mean spherical candle-power may be found. The present author points out that this recommendation is important for the new half-watt lamps. With carbon lamps and the old metallic-filament lamps it was sufficient to give the mean horizontal candle-power, because for these lamps the ratio of the mean spherical candle-power to the mean horizontal candle-power is practically constant, the value being 0.8. If one speaks of such a lamp with a specific consumption of 1.1 watts per hefner candle, one means that 1.1 watts produces 0.5 hefner candle in the horizontal direction, although one mean spherical candle-power requires 1.375 watts. With the new nitrogen-filled lamp with the filament in form of a spiral coil, there is the difficulty that the ratio of horizontal candle-power to mean spherical candle-power varies within rather wide limits. It is therefore necessary in giving the specific consumption to base it on the total light sent out from the lamp. This equals $4\pi J_o$. The author urges that incandescent-lamp manufacturers should agree to give in future the specific consumption per mean spherical candle-power. In the period of transition one might say, for instance, that a lamp has the same specific consumption as a standard metallic-filament lamp of 1 watt. For a basis of comparison the following values may be used: A standard metallic-filament lamp with a specific consumption of 0.8 watt per horizontal hefner candle-power has a specific consumption of 1 watt per mean spherical hefner candle-power. In the same way 1 watt per horizontal hefner candle-power corresponds to 1.25 watts per mean spherical hefner candle-power. Further, 1.1 watts per mean horizontal hefner candle-power corresponds to 1.375 watts per mean spherical hefner candle-power. The author urges that such an agreement is very important, for even skilled incandescent-lamp engineers are often in doubt how to "load" correctly the new types of lamps since the simple determination of the horizontal candle-power may lead to great errors. A simple method for determining whether two lamps are equally loaded is the use of a Lummer-Brodhun photometer, especially in the form of the contrast photometer. If the photometer field illuminated by the one lamp on the left is yellow in color while the photometer field illuminated by the other lamp on the right is blue, it must be concluded that the lamp on the right carries the greater load. If the lamp on the right is the standard lamp or the lamp of comparison, it is necessary only to increase the voltage of the lamp on the left until the two photometer fields show exactly the same color. When the new tungsten lamps having their filaments in the form of spiral coils are tested the peculiar result is found that the specific consumption per mean spherical candle-power is higher than for lamps with a straight filament.—*Zeit. f. Beleucht.*, May 30, 1914.

Vapor Arc Lamps.—A note on a recent British patent (No. 15,406, 1913) of the Deutsche Gasglühlicht Aktien-Gesellschaft. The body of the lamp is filled with a gas which, during the operation of the lamp by the vaporized mercury, is driven out of the arc chamber into either a special cooling chamber or the atmosphere. In the latter case the gas used is air; in the former neon or argon can be employed. The outlet from the arc chamber must be long enough to prevent the escape of the mercury vapor. To start the lamp the mercury is caused to boil either by external heating or by tilting the lamp so as to short-circuit the anodes.—London *Elec. Eng'ing*, May 28, 1914.

Generation, Transmission and Distribution

Suppression of the Third Harmonics.—R. JOHS. JENSEN.—The third harmonics in the voltage curve of an alternator can produce telephone disturbances if the neutral point of the dynamo is earthed. Former proposals made to overcome this disadvantage are briefly discussed and a wiring diagram is given showing a new

method by means of which the third harmonics are entirely avoided. This method of wiring shown in Fig. 1 is analogous to the zigzag connections of a three-phase transformer. In the figure, *I, II* and *III* are the three phases of the machine. Each phase is subdivided into two equal parts 1 and 2 so that the machine must be built with an even number of slots per pole and per

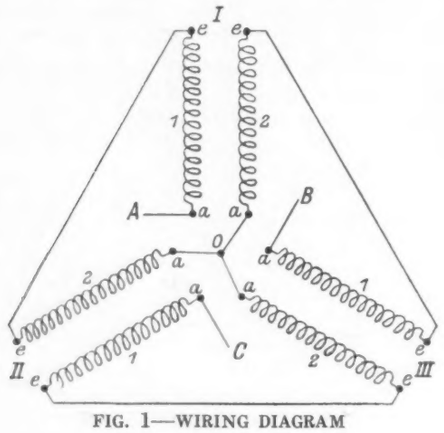


FIG. 1—WIRING DIAGRAM

phase. Oscillographic voltage curves are given for a machine built according to this design and for an ordinary alternator.—*Elek. Zeit.*, June 4, 1914.

Electrophysics and Magnetism

Experiments with an Incandescent Lamp.—C. W. S. CRAWLEY AND S. W. J. SMITH.—A note on a (British) Physical Society paper. The first of these experiments was due to Addenbrooke, who, using a 100-volt lamp filled with paraffin oil (the tip being removed) as a convenient high resistance in a 200-volt circuit, noticed that some of the many bubbles forming on the filament behaved in a curious way. Instead of rising at once to the surface from the point at which they formed, they ran down the legs of the filament, against gravity, and then escaped at the leading-in wires. Smith, led to repeat this experiment by Crawley, discovered another even more striking phenomenon. Placing the 100-volt lamp in a 100-volt circuit in series with a variable resistance (conveniently a water trough) it was found possible, by momentarily cutting out most of the resistance, to obtain a single bubble upon the wire. The behavior of such a bubble is very interesting to watch. Instead of escaping at either terminal, as in Addenbrooke's experiment, it travels backward and forward between the two, "looping the loops" of the filament in a fascinating way during every journey. The peculiarities of this phenomenon, which can be obtained with either direct or alternating supply, have been analyzed by examining the size and motion of the bubble under various conditions and also by using filaments of different materials and liquids of different boiling points. It was shown from the experiments that a rapid fall of temperature from the wire through the liquid, in the region through which the bubble moves, is an essential condition of the phenomenon, and also, from theoretical considerations, how this condition can be used to explain why the bubble moves in the manner described. Crawley pointed out, in connection with the first experiment, that the lamp proved most satisfactory, being able not only to absorb more power than with a vacuum, but also to stand momentary overload much better.—London *Electrician*, June 5, 1914.

Electric Brush Discharge in Solutions.—HAROLD SMITH.—An account of an experimental investigation on the spectroscopy of the electric brush discharge in weak acids and solutions. The brush was produced by means of an alternating-current transformer. The secondary terminals were connected to two platinum electrodes immersed in a small cell containing a solution. The author extended his observations into the ultraviolet region of the spectrum and investigated the differences which may occur between the positive and the negative brush. The chief results are as follows: The series and secondary spectrum of hydrogen are a great deal brighter in distilled water than in solutions for the same current value. In distilled water they are stronger in the negative brush than in the positive for the same current. When the potential drop through the brush is the same in each case, the spectra are strongest in the positive brush. In solutions the intensity of the spectra relative to the rest of the brush spectrum (water-vapor bands, platinum and oxygen lines, etc.) is considerably diminished. Neither the nature of the solution or the sign of the brush has any perceptible effect. There is no certain indication that electrolysis plays any part in the appearance of the spectra. The spectrum of the metallic lines of the solute appear in the negative brush in solutions. For constant current the spectrum grows in intensity with the concentration till a certain value of the concentration is reached, when no futher increase occurs. The spectrum appears in the case of the positive brush in the strongest solutions, and then only very faintly. The behavior of the spectrum in all cases can readily be explained from the point of view of electrolysis. The elementary line spectrum of oxygen appears in distilled water in both the positive and negative brush. In dilute acids, solutions of magnesium and zinc sulphates, and in tap-water, it appears in strength in the positive brush, but is generally absent or very weak in the negative. In solutions of salts of lithium, sodium and potassium its appearance in the positive brush is the same as for other solutions; in the negative brush the spectrum appears with the metallic lines of the salt, increases in intensity with them, and reaches its maximum with the same concentration of solution. The negative bands of nitrogen behave in the same manner. In the negative brush both the positive and negative bands appear in general remote from the point, while the oxygen lines are always produced close to the point. The arc spectrum of platinum appears in the negative uncondensed brush. In the condensed brush the spark lines appear. When copper wire is used in the point electrode the copper lines appear in each brush, but are strongest in the negative. The water-vapor bands appear in each brush equally well.—*Philos. Mag.*, May, 1914.

Units, Measurements and Instruments

Measuring Inductances.—W. HAMILTON WILSON.—An illustrated description of a convenient method for measuring inductance. Three different arrangements are shown in Fig. 2. The inductance to be measured is indicated by L, while A is a movable-coil direct-current ammeter, B a battery, I an interrupter, S a switch, V a voltmeter, and r_1 and r_2 non-inductive resistances. The interrupter I in the first left-hand diagram is a motor-driven insulating disk carrying a convenient number of contact pieces on its periphery, which make and break the battery circuit N times per second. The measurement may be made as follows: On rotating the interrupter with the switch S open, a reading A_1 is obtained on the movable-coil ammeter A. This reading can be adjusted to a convenient value by means of a non-inductive resistance r_2. The switch S is then closed, causing the ammeter reading to fall to a value A_2, due to the discharge of a quantity of electricity from the inductance on interruption of the magnetizing current. This discharge takes place through the circuit

L, S, A, r_2, r_1, and its direction through the ammeter is opposite to that of the battery current. If C is the magnetizing current interrupted and R is the total resistance of the circuit L, S, A, r_2, r_1, then the inductance $L = (A_1 - A_2)\,R/(NC)$ henries. Much greater sensibility may be obtained by adopting a form of interrupter having a slip-ring and making the connections

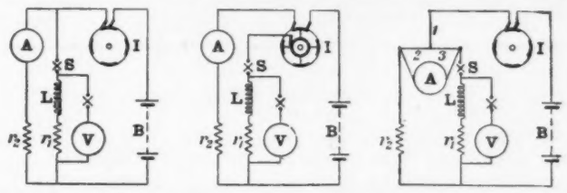


FIG. 2—ARRANGEMENTS FOR MEASURING INDUCTANCES

as shown in the second (central) diagram. By adjusting the brush connected to the ammeter so that it makes contact just before the other brush breaks contact with the battery, the initial resistance A_1 can be greatly cut down without increase of the resistance r_2. Hence the ammeter may be used with a shunt suitable for a smaller current. Any vibration of the brushes may cause variation in the ammeter reading A_1, owing to alteration in the time of contact, rendering it difficult to obtain the difference $(A_1 - A_2)$ accurately. The discharge current from the inductance may be read as a direct quantity by adopting the arrangement in the third (right-hand) diagram, in which 1, 2 and 3 are non-inductive resistance shunts. The readings in this case are less susceptible to vibration.—London *Electrician*, May 29, 1914.

Insulation Testing Set.—An illustrated article on the "metrohm" insulating testing set of English make. The arrangement of the ohmmeter is shown in Fig. 3. The upper coil carries a current proportional to the voltage and the lower coil one inversely proportional to

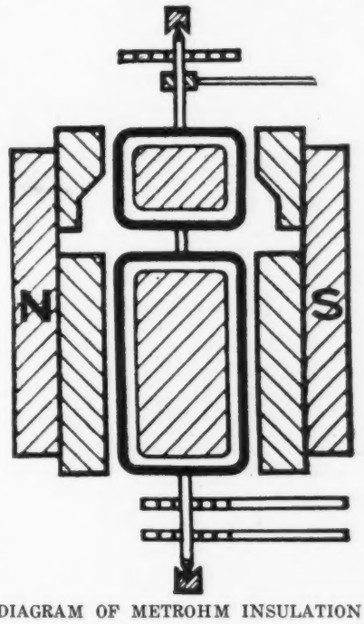


FIG. 3—DIAGRAM OF METROHM INSULATION TESTING APPARATUS

the resistance under test. The polar extensions are so shaped that the control exerted upon the former coil depends on its angular position, this latter being consequently a measure of the resistance under test, and that independently of the pressure. By appropriately shaping the pole pieces, almost any desired range and form of scale can be obtained. The insulating testing set comprises such an ohmmeter together with a generator combined in one case, the generator in the standard pattern giving 500 volts while the instrument is scaled up to 50 megohms.—London *Electrician*, May 22, 1914.

Telegraphy, Telephony and Signals

Electromagnetic Radiation.—LOUIS COHEN.—A mathematical paper giving a new method for deriving Hertz's formulas for the distribution of the electromagnetic forces and the radiation from a cylindrical oscillator. These formulas are being used considerably in wireless telegraphy. The present author's method of derivation employs only elementary mathematics.—*Journal Franklin Inst.*, April, 1914.

Wireless Telegraphic Measurements.—J. ERSKINE-MURRAY.—A paper read before the Wireless Society of London. The author describes the various methods of measurement of the different radio-telegraphic quantities. In this way he deals with power, current, voltage, capacity, inductance, coupling, wave-length decrement and efficiency.—London *Electrician*, June 5, 1914.

Book Reviews

WHERE AND WHY PUBLIC OWNERSHIP HAS FAILED. By Yves Guyot. Translated from the French by H. F. Baker. New York: The Macmillan Company. 460 pages. Price, $1.50.

The attitude of the author is expressed exactly in the following extract from his preface: "I have vainly sought for the benefit arising from public operation by state and municipalities. On the contrary, an unbiased survey of the whole subject forces me to testify to the resulting harm." The book contains an invaluable collection of data in regard to public ownership and operation of utilities, principally in European countries. It presents the thorough conviction of the author that public ownership and operation are costly from a financial standpoint and unsatisfactory from a service point of view. It shows, as many observers have contended, that where public ownership begins the tendency is for it to continue until it embraces not only all kinds of public enterprises but also many kinds of undertakings which are essentially not of a public character.

WIRELESS TELEGRAPHY. A Handbook for the Use of Operators and Students. By W. H. Marchant. 242 pages, 154 illus. New York: Whittaker & Company. Price, $1.60.

This book has been written from a thoroughly practical viewpoint and contains much information of use to those experimenting with, operating and studying radiotelegraph apparatus. Though written to meet British radio conditions, the data and descriptions of the Poulsen, Telefunken, Lepel, Goldschmidt and Marconi apparatus, as well as the chapters on measurements and localization of faults, make the book of general interest. There is very little to be criticised in the simple presentation of wireless technology, though it is regrettable that in a publication of 1914 so little matter is given concerning advanced radio practice. For example, many readers would doubtless have been gratified by a treatment of the gaseous detectors and heterodyne receiver as clear and specific as that given to the Brown relay and the Poulsen high-speed transmitter. The utility of the chapter on measurements to the average radio man could be made still greater by the addition of a little more introductory instruction. However, as the book now stands it should fill the need of a simply worded and readable handbook of reasonably restricted scope.

New Apparatus and Appliances

An Illustrated Descriptive Record of Recently Developed Manufactured Products of Interest to Electrical Readers

Stripping Plier

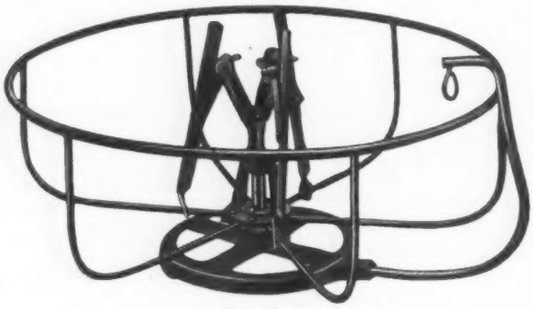
A plier for stripping insulated wire is shown herewith. The stripping is accomplished by means of two stripping blades, one of which is in each member of the plier immediately behind the head. The body of

PLIER FOR STRIPPING INSULATED WIRE

the blades is threaded, making possible very minute adjustment. The blades can be used both for cutting and stripping insulation, a narrow cutting edge being utilized for the former and a broad stripping edge for the latter. A screwdriver is used for adjusting the blades, which are renewable. This plier can also be employed as a flat-nose and side-cutting plier. The Smith & Hemenway Company, 150 Chambers Street, New York, is placing this stripping plier on the market, as an addition to its series of linemen's and electricians' tools.

Wire Reel

The reel illustrated herewith is designed for use with any kind of wire manufactured, whether bare or insulated, single-strand or multiple. Wire can be drawn off the reel at any speed without snarling, tangling or kinking, the manufacturers claim. The coil is held in a basket which revolves on a ball bearing and prevents the wire from escaping. The wire is fed out through a loop on a stationary arm, and when the operator stops reeling the wire the reel automatically brakes itself. This "real" reel, as it is called, has no wearing parts and no loose parts, and needs no oiling. For dealers in wire this reel has proved a great convenience in winding off wire for sale. The device is

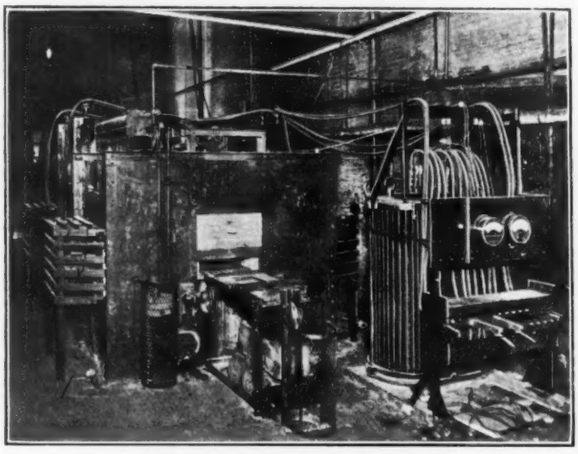


WIRE REEL

made in two stock sizes, the "standard," weighing 12 lb. and measuring 24 in. in inside diameter, and the "junior," weighing 6 lb. and measuring 12 in. in inside diameter. This reel is being manufactured by the Wiring Equipment Company, 30 Church Street, New York.

Electric Furnace

An interesting electric-heating furnace for annealing brass and German-silver flat-ware blanks was recently installed in the plant of a plated-tableware manufacturer at Niagara Falls, N. Y. The furnace framework is made of steel, and the furnace is 15 ft. long, 8 ft. wide and 7 ft. 6 in. high. Doors are placed at both ends of the furnace. A mechanical pusher operated by compressed-air cylinders runs over cast-iron idler sheaves. The mechanism for operating this pusher is at the charging end of the furnace. The material under treatment is packed in steel pans 20 in. square, which are forced through one after another, seven pans being in the furnace at one time. When passing through the furnace the pans are supported by a hearth made of cast-iron grids 24 in. square, so designed that undue warping at ordinary furnace temperatures is prevented. When coming out of the discharge end of the furnace the pan is automatically



ELECTRIC ANNEALING FURNACE

emptied into a water-sealed discharge hood. The metal under treatment falls into a tank of either clear water or pickling solution, depending upon the cleanliness of the material before it is placed in the furnace. The pan itself is caught by two rails and is held suspended above the trough, and it may be taken out from under the water-sealed hood through a counter-balanced swing door.

The electrical equipment consists of a 200-kva transformer, built by the Pittsburgh Transformer Company, which is arranged with twelve voltage taps connected to the controller shown in the illustration. The switch is mounted on a switchboard frame in front of the transformer. The instruments on the switchboard panel consist of a Weston wattmeter and a Foxboro pyrometer. The latter is connected to a 48-in. couple placed directly over the pan about to be pushed out of the furnace, making it possible to know at what temperature the material is drawn. This furnace was installed by the Electric Furnace Company of America, Alliance, Ohio.

Outlet-Box Receptacle and Cover

An outlet-box receptacle, formerly equipped with a flat cover and now fitted with a cup cover which gives

OUTLET-BOX RECEPTACLE AND COVER

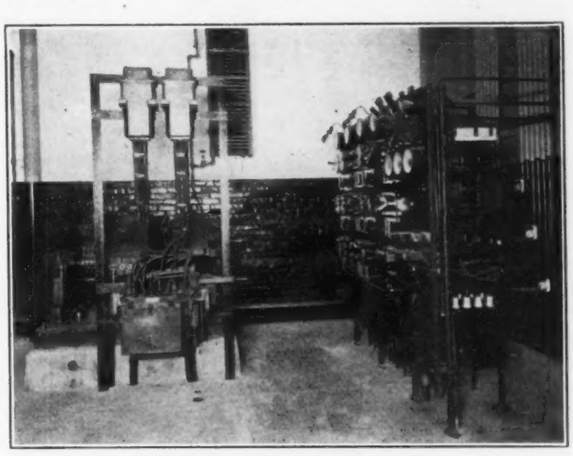
more room for wiring in the box, is shown in the accompanying illustration. The device is made by Pass & Seymour, Inc., Solvay, N. Y.

Automobile-Charging Set

An electric-vehicle-charging set has recently been installed in the garage of the Curtis Publishing Company, Philadelphia, Pa., one of the interesting features of which is the provision for keeping records of the energy used by the various cars.

The switchboard is sectional. On the right is a large panel which controls the motor-generator set. This panel is equipped with a generator circuit-breaker switch, ammeter, voltmeter, field rheostat, and at the bottom a reverse-current relay which opens the circuit-breakers should the direct-current voltage fall below the voltage of the batteries being charged. A line voltmeter and circuit-breaker for the alternating-current circuit are also mounted on this panel. On the left are two series of sections which control the charging circuits to the car batteries. Each section controls two circuits and each circuit is assigned to a single car, a small name-plate designating the circuit.

At the top of each vertical row of sections is an ammeter and a voltmeter which are so connected with the charging line that the operator at the switchboard can tell precisely the condition of charge of the car batteries on any individual circuit at all times and does not



AUTOMOBILE-CHARGING OUTFIT

have to depend on the automobile instruments. In fact, aside from connecting and removing the charging plugs, which are connected to lines running into the garage, the operator performs all the operations at the switchboard.

Watt-hour meters are mounted on the charging sections. Two scales are provided. One, which is set at zero for each charge, shows the amount of each separate charge, and the other shows the total amount of energy used by the car for a given date. Thus, an exact record of the energy consumed by each car can be obtained for any desired period, and one of the important elements of cost of operation for each car can be exactly determined. Fuses to protect the battery from overload and a resistance-adjusting rheostat complete the equipment for each circuit.

The entire equipment for this installation was supplied by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Portable Electric Grinder

A grinder of the so-called "aerial" type is being placed on the market by the Standard Electric Tool Company, Cincinnati, Ohio. The device is designed for surfacing rough castings and for buffing. This tool is

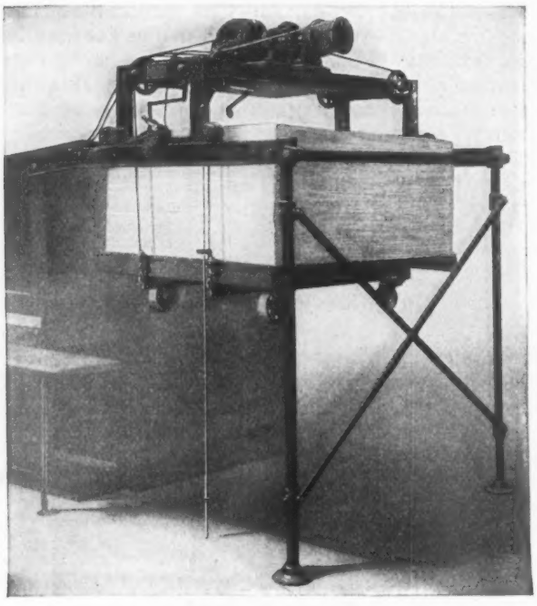
PORTABLE ELECTRIC GRINDING TOOL

equipped with a motor operating on either direct current or alternating current, and it is especially adapted to twenty-five-cycle, thirty-cycle and forty-cycle circuits. The motor is form-wound and is impregnated with bakelite. This grinder is designed to operate at a speed of 6000 r.p.m., and is fitted with an emery wheel 4 in. in diameter with a 1-in. face. Ball bearings incased in grease in dust-proof chambers are employed throughout. The motor is rated at 0.5 hp. This tool is equipped with a spring for suspending from the ceiling, or it can be operated from a traveler with a counterbalance.

Electrically Operated Paper Lift

The paper lift illustrated herewith is practically an electric elevator and is designed to lift a day's run of paper, truck and all, to a point slightly above the level of the feedboard of a printing press. This lift is built in two styles, one with four posts and the other with two posts and two extension arms for bolting to the press frame. The former is for use where plenty of space is available; with the latter about 6 in. of room is saved. The uprights are made of 2-in. pipe and are

equipped with flange feet for bolting to the floor. The cross-members are steel I-beams. Either a direct-current or an alternating-current 0.75-hp motor may be



ELECTRIC PAPER LIFT

used. The direct-current motors are wound so that the speed varies with the weight of load. The empty truck is lowered at a rate of about 3 ft. per minute. The weight of the device complete is 1400 lb.

The operation of this electric lift is as follows: The truck load of stock is wheeled back of the press. The steel-wire elevator ropes of the lift are hooked to ends of through-bars slipped under the truck. The motor is then started and the truck load of paper is slowly raised until the top of the pile is about 4 in. above the rear of the feed board. A balanced trip-finger then shuts off the motor and the stock is held suspended. The press feeder slides off his "lift" and presses a lever which starts the device in motion again. Each time the feeder slides off a lift he moves the lever, and while he is feathering out his lift the lifting device raises the rest of the stock to the proper level above the feed board.

This lifting device is being manufactured by H. B. Rouse & Company, 2214 Ward Street, Chicago, Ill.

Keyless Socket

An inexpensive keyless socket with porcelain wall base, which is adapted to all kinds of wall and ceiling work, is shown herewith. The supporting screw holes

KEYLESS SOCKET

are spaced on 1 3/16-in. centers and will fit outlet boxes with corresponding screw spacings. This socket is being made by Harvey Hubbell, Inc., Bridgeport, Conn.

Illuminating Glassware

"Parian" is the name chosen for the illuminating glassware being placed on the market by the H. W. Johns-Manville Company, New York. This name was selected because of the close resemblance of the material to Parian marble. Parian ware is said to absorb a small amount of light, and the diffusion it produces is pleasing to the eye. This new ware is suited for stores, offices, churches, theaters, public buildings, auditoriums and residences, where harmony and beauty are important considerations. Various period designs have been produced and are being worked into bowls, hemispheres, spheres, wall lamps, pendants and reflector shades. A wide choice of colors is also available.

Three-Wheeled Electric Vehicles for Hotel Deliveries

Three-wheeled electric vehicles are being employed by Stern Brothers' department store, New York, to make deliveries to hotels. This special type of delivery wagon has been assigned to hotel service, as transient customers seldom buy heavy goods and consequently the weight of the vehicles delivering them does not have to be distributed over so many wheels. More prompt deliveries can be made with these cars, as they are better adapted to maneuvering through crowds and can be turned around easily in restricted quarters.

The delivery wagons are capable of carrying 500 lb. for a distance of 35 miles at a speed of 12 miles per hour. The battery is installed under the seat, and the motor is mounted in a vertical position over the front wheel, which exerts the entire tractive effort. The vehicles were manufactured by the Berliner Electrik Fabrik.

At the present time Stern Brothers are keeping their

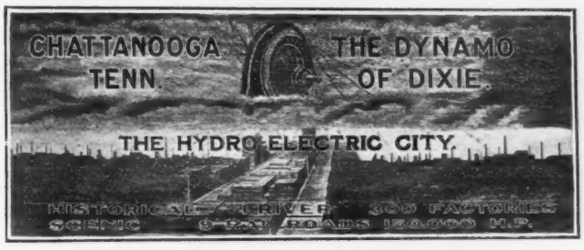
THREE-WHEEL ELECTRIC DELIVERY WAGON

vehicles in a public garage pending the completion of their own garage, which will be on the New York Edison Company's service.

Jobber, Dealer and Contractor

Chattanooga's Co-operative Electric-Lighted Sign

At Chattanooga, Tenn., the Tennessee Power Company is donating the energy to illuminate a large civic sign recently painted under the auspices of the Chamber of Commerce on a conspicuous wall in the business district. The sign measures 35 ft. by 100 ft. in size and



CHATTANOOGA'S CO-OPERATIVE SIGN

is lighted at night by a 2000-cp nitrogen-filled tungsten lamp in a locomotive reflector installed on an adjacent roof.

Labor and material were furnished by several local firms so that the sign was erected without cost to the Chamber of Commerce. The owner of the building donated the wall space, a paint merchant furnished the paint, and the W. C. Teas Company did the electric wiring. Among the local Jovians who took part in the project were Messrs. F. W. Hoover, L. J. Wilhoite, P. J. Kruesi and P. W. Curtis.

Code Requirements Not Binding Unless Specified

Justice Mercier, of Montreal, Canada, has decided that an electrical contractor is not bound to do his work in compliance with the regulations of the insurance companies unless it is so stipulated in his contract. The Routtenberg Company ordered a four-hundred-dollar electric sign from the Macey Sign Company, but when the sign was delivered refused to pay for it, claiming the wiring was not up to the Underwriters' standard. The court held that the sign had been made in accordance with all requirements of the contract, and that therefore payment must be made.

Electrical Concerns to Pay Increased Compensation Premiums in Ohio

That injuries to electrical workers have called for compensation amounting to 104 per cent of the amount resulting from premiums collected from their employers is set forth in a recent report of the Ohio Industrial Commission showing the results of the operation of the compensation law during the past two years. The general average of disbursements to premiums is 82 per cent, indicating that the rate for electrical concerns is too low. Coal mines, paper mills, milling and oil working are other industries where the compensation paid has exceeded the revenue. It has been announced that a readjustment of the rates, on a generally lower level, will be made shortly, based upon the experience of the commission so far, and if this be done it seems certain that the rates applicable to central stations and others employing electricians will be considerably increased.

Louisville Electrical Clearing House to Reorganize

The Louisville (Ky.) Electrical Clearing House Association, which has been conducted under the auspices of the Kentucky Actuarial Bureau during its entire existence, is to be reorganized on an independent basis. The meetings, however, will continue to be held at the offices of the Actuarial Bureau in the Starks building. The executive committee of the clearing house association, consisting of President C. C. Childers, Vice-president F. G. Burdorf and Secretary E. C. Knoop, is working out the reorganization plans.

The last meeting of the association was characterized by the attempt to secure a modification of the requirements for loop-system wiring, but the members adhered to their original stand. At the next meeting a committee representing fixture men will report on the insulation of canopies, while five members of a committee charged with looking into the present regulations on conduit installation will also make a report.

Effective Sign Used by Quebec Electrical Supply House

The electrical supply and fixture house of Goulet & Belanger, Quebec, Canada, makes effective use of electrical advertising, and a recent example of the firm's enterprise is illustrated in the accompanying halftone. On a busy street corner about 200 ft. distant from the store in a diagonal direction the firm erected a huge wooden hand 9 ft. long and 20 ft. high above a vacant lot passed by some of the principal street cars. The emblem was equipped with seven 25-watt tungsten lamps placed inside metal reflectors spaced 18 in. apart and attracted much attention during its "tenure of office." Like many signs in Quebec, the one illustrated appealed to the local population in the prevailing lan-

ELECTRICAL SUPPLY DEALERS' SIGN

guage of the Gallic race, and a keen sense of advertising value was shown in making "Toujours" rather than the firm name the dominating word.

Industrial and Financial News

Public Utility, Commercial, Corporate and Trade Developments—The Electrical Material and Security Markets

New Work at Madison Lake, Minn.—The village of Madison Lake, Minn., which recently granted a franchise to the Consumers' Power Company (Faribault division) for the distribution and sale of electricity, has now contracted with the company for its water pumping and city lighting requirements. Construction of the transmission line and distribution system will be started at once.

Underground Construction "Runs Into Money."—A recent computation puts the total of the conduit owned by the Commonwealth Edison Company of Chicago at 18,961,333 duct-feet. The company's investment in conduit (including tunnels), cable, services, etc., is about $19,000,000, or about 22 per cent of the total assets of the company. The amount of conduit installed by the company in 1913 was about 1,500,000 duct-feet.

Six Years' Experience Under Regulation.—In connection with its campaign against the development of State water-power in New York, the Empire State Gas & Electric Association has issued a pamphlet containing an address made by Mr. James T. Hutchings, Rochester, N. Y., at the last annual convention of the New York State Waterways Association on "Six Years' Experience of Public Service Corporations Under State Regulation."

Electrical Energy for Cleaning Pullmans.—Among the contracts recently closed by the commercial department of the Louisville Gas & Electric Company was one for supplying electrical energy for an installation of three small motors for operating vacuum cleaners used by the Pullman company in cleaning its sleeping cars. Posts will be installed in the yards with wiring connections so that a car can be connected at any point in the yard.

Brooklyn Tobacco Factory to Use Central-Station Service.—The Edison Electric Illuminating Company of Brooklyn has just completed the extension of its mains for the complete supply of electricity to the Brooklyn manufactory of the American Tobacco Company, one of the largest factories engaged in the cigarette industry, replacing at that point the entire boiler, engine and generator plant by service from the Edison mains. Direct-current service is supplied and a long-term contract has been signed.

Reduction in Rates.—The Hartford Electric Light Company of Hartford, Conn., has announced a reduction in electric-lighting rates both for domestic and commercial use, taking effect July 1, from 9 cents per kw-hr, with 5 per cent discount, to 8 cents per kw-hr, with 5 per cent discount. This reduced rate will be effective throughout the whole territory served by the company. In the last ten years the company has reduced its rates from 17 cents per kw-hr. to the present new rate of 8 cents per kw-hr. The company serves a population of 125,000 and has about 15,500 customers.

Starting and Lighting Equipment for Automobiles.—The Standard Steel Car Company, Butler, Pa., has adopted the Westinghouse electric starting equipment for its 1915-model automobiles. This equipment will consist of a 6-volt starting motor with electrically operated control switch and a 6-volt generator with switches, fuse boxes and ammeter. The Dorris Motor Car Company, St. Louis, Mo., will also use the Westinghouse equipment for starting, lighting and ignition on its 1915-model cars. This equipment consists of a combination ignition and lighting generator, together with a complete set of switches, fuse boxes, junction boxes and a starting motor with switch and ammeter.

Electrical Equipment for Utility Companies.—Among the utility companies which have ordered new electrical apparatus are the following: The Athol Gas & Electric Company, Templeton, Mass., a 300-kw rotary converter; the Cohoes Company, Cohoes, N. Y., three 9000-kva alternating-current waterwheel-driven generators, two 165-kw, two-unit, three-bearing motor-generator sets, four 400-kva transformers, four auto-feeder regulators, a switchboard and accessories; the Newell Water & Power Company, Newell, W. Va., a 300-kw Curtis turbo-alternator; the Southern Power Company, Charlotte, N. C., three 2000-kva oil-cooled transformers; the Keno Power Company, Keno, Ore., a 450-kva alternating-current generator with a 20-kw exciter, two 300-kva transformers and switchboard. The above equipment will be furnished by the General Electric Company.

Extension of Waterside Generating Station at Louisville.—Work is in progress for the enlargement of the Waterside generating station of the Louisville Gas & Electric Company. This company is controlled by H. M. Byllesby & Company through the Standard Gas & Electric Company. Excavation is being made and piles are being driven for a steel-concrete addition with ground dimensions 27 ft. by 110 ft. Four Babcock & Wilcox water-tube boilers will be added, as well as superheaters, coal and ash conveyors and overhead coal bunkers having a storage rating of 85 tons for each boiler. Preliminary arrangements have been made for the installation of an additional General Electric 5000-kw horizontal turbo-generator complete with surface condenser, a separate exciter and other auxiliaries. This station, which was described in the *Electrical World* of Oct. 25 and Nov. 1, 1913, is the principal generating station of the Louisville company named.

New Steam Power Station for Public Service Company.—The Public Service Electric Company of New Jersey has preliminary work under way for the construction of a large power station at Point-No-Point on the Passaic River. The plant property covers an area of 16 acres, and the plant will be known as the Essex station. When fully completed it will be one of the largest steam plants in the country, having an ultimate rating of 150,000 kw. Although it is not intended to build the plant with the full rating at once, something like $2,000,000 will be spent within the next year, and the station will be so designed that it can be enlarged to meet the demands of future growth. Much has already been done in the way of preparing the ground and securing data to pave the way for awarding contracts. As the land was practically inaccessible for business purposes, the company has built a road about 2000 ft. long to the nearest street. Proposals have been invited for the building of a dock which will have a total length of 682 ft. and which will extend from the pierhead line back to the present high-water mark, a distance of about 65 ft. Intakes for condensing water will be built through the dock and the latter will be arranged to accommodate the coal-handling machinery. The company will have the water route as well as two railroads to carry its coal supplies. In its finished state the building will measure 366 ft. by 285 ft. Two turbines rated at 25,000 kw each will be installed, leaving room for a third unit. Space will be provided for eight boilers, although only four will be set up. It is expected that bids will be asked for the foundation early in August, and that the plant will be in operation in the late summer or early fall of next year.

Electric Truck Sales in Massachusetts.—The General Vehicle Company's Boston office reports the sale of three 5-ton electric trucks for service on the new South Boston fish pier, the machines being of the electrically operated dumping-body type and designed for carrying cracked ice from a refrigerating plant at the head of the pier to fishing smacks moored alongside the wharf. The new pier supersedes T-wharf, a famous old-time receiving and distributing market in the Boston fish trade, and will shortly be operated by an elaborate electrical and mechanical plant for motor, lighting and cold-storage service. These trucks are the

first of a fleet and are to be operated with gravity delivery into the holds of the vessel, the backs overhanging the wharf during discharge, which can be made in one minute from the arrival of the truck at the vessel's side. The complete installation will consist of six 5-ton trucks, which will take the place of about twenty ordinary ice carts. The batteries will be charged on the pier. Pending the completion of the refrigerating plant, the trucks are utilized in the haulage of coal. The American Sugar Refining Company, Boston, has just installed a 7-ton electric truck for the haulage of sugar, the machine having the largest body of any truck in Boston. At New Bedford, Mass., special activity is apparent in the electric-vehicle field. Ten electric business wagons have been placed in service by the New Bedford Gas & Edison Light Company, and a fleet of delivery wagons has lately been adopted by the Pairpoint Corporation and the J. V. Spare Dry Goods Company.

Electrical Equipment for Textile Manufacturers.—A number of orders have recently been received by the Westinghouse Electric & Manufacturing Company for installations in the textile industry. Among the companies which have ordered this equipment are the following: Waltham Bleachery & Dye Works, Waltham, Mass., thirteen motors totaling 400 hp; River Spinning Company, Woonsocket, R. I., seven motors totaling 230 hp, and two 37.5-kva transformers with one three-panel switchboard; American Woolen Company, Fulton, N. Y., three 1160-kva waterwheel alternators with three 30-kw exciters and one 75-kw motor-generator set with one fourteen-panel switchboard; John H. Meyer & Company, Bloomsbury, N. J., one 75-kva turbo-generator unit and an exciter with a three-panel switchboard and four motors totaling 35 hp; J. & J. Dobson, Inc., Philadelphia, Pa., one 470-kva low-pressure turbo-generator unit, one Westinghouse-LeBlanc barometric condenser, two motors totaling 500 hp, one 25-kw turbine-driven exciter, one 16-kw motor-generator exciter set and one six-panel switchboard; Pennsylvania Textile Company, York, Pa., one 562-kva belted alternating-current generator, one 22.5-kw belted exciter and twenty-three motors totaling 600 hp; Orr Cotton Mills, Anderson, N. C., one 1000-kva turbo-generator, one 10-kw turbo-exciter set, one Westinghouse-LeBlanc condenser, one 12.5-kw motor-generator set and one four-panel switchboard; Cliffside Mills, Cliffside, N. C., one 375-kva turbo-generator with exciter, one 125-kva turbo-generator, one 18-kw generator, two motors totaling 480 hp and one four-panel switchboard; Flint Manufacturing Company, Gastonia, N. C., two 200-kva self-cooled transformers with one two-panel switchboard, fourteen motors totaling 300 hp and thirteen oil circuit-breakers; Brown Manufacturing Company, Concord, N. C., ten motors totaling 290 hp, six oil circuit-breakers and four auto-starters; Aurora Cotton Mills, Burlington, N. C., three 100-kva, 22,000-volt outdoor transformers, one outdoor substation complete, eleven motors totaling 240 hp; Pelzer Manufacturing Company, Pelzer, S. C., two 100-hp motors, two 300-kva self-cooled transformers and one four-panel switchboard; Lang Manufacturing Company, West Point, Ga., thirteen motors totaling 275 hp, three 100-kva, 11,000-volt transformers and one 15-kva, 11,000-volt transformer with one three-panel switchboard and one electrolytic lightning arrester.

Central-Station Business in the Central States.—The accompanying data regarding the April earnings and output of lighting and motor-service companies in the Central States may be compared advantageously with the returns of March published in the *Electrical World* of May 30. In Table I are given the April returns for sixteen companies in Ohio, Michigan, Wisconsin and Indiana, while Table II contains a comparison of these returns with those of the same companies for March. On the basis of output, these companies between them represent somewhat over 70 per cent of the entire lighting and motor-service industry in the four states. The March percentage of 13.2, which was found to represent the rate at which 1914 earnings were increasing over 1913, was satisfactory enough; and it is somewhat striking to notice that for April the demonstrated rate of increase works out as high as 16.4. This is probably a little better than the true average for the year, but it would at least seem that in these states the year 1914 is securing a steady increase in revenue from the sale of energy of some 14 or 15 per cent over the year 1913. From Table II it will be noted that the companies reporting to the *Electrical World* show increased earnings for April over March, while reporting a considerable decrease in energy output. This same condition, it may be remembered, was reflected by the data from the Atlantic States published in last week's issue of the *Electrical World*. April contains one day less than March in addition to possessing more daylight hours, and the energy demand naturally falls off. Revenue would also fall off (though possibly not to the same extent) if the figures of dollars related strictly to the calendar month; but the earnings data for March did not cover the thirty-one calendar days of that month, and those for April probably indicate a truer monthly average. Five other companies in Wisconsin, Indiana and Illinois not included in the March returns have reported for April, and

TABLE I—EARNINGS AND OUTPUT FOR APRIL, 1914 AND 1913, FOR SIXTEEN CENTRAL-STATION COMPANIES IN FOUR EAST NORTH CENTRAL STATES

	Gross Earnings from the Sale of Energy			Total Energy Output in Kw-hr.		
	April, 1914	April, 1913	Per Cent Increase	April, 1914	April, 1913	Per Cent Increase
Ohio	$1,289,133	$1,078,408	19.7	49,308,386	41,090,470	20
Michigan	773,903	687,134	12.8	38,954,629	35,099,231	11
Wisconsin and Indiana	334,130	295,817	13.0	18,991,829	17,247,704	10.2
Total	$2,397,166	$2,061,359	16.4	107,254,844	93,437,405	14.8

TABLE II—COMPARISON OF EARNINGS AND OUTPUT FOR MARCH AND APRIL, 1914 AND 1913, OF ABOVE SIXTEEN COMPANIES IN FOUR EAST NORTH CENTRAL STATES

	Gross Earnings from the Sale of Energy			Total Energy Output in Kw-hr.		
	1914	1913	Per Cent Increase	1914	1913	Per Cent Increase
March	$2,339,496	$2,068,666	13.2	119,175,200	104,470,876	14.1
April	2,397,166	2,061,359	16.4	107,254,844	93,437,405	14.8

TABLE III—COMPARISON OF EARNINGS AND OUTPUT FOR MARCH AND APRIL, 1914 AND 1913, OF FIVE COMPANIES IN THE WEST NORTH CENTRAL STATES

	Gross Earnings from the Sale of Energy			Total Energy Output in Kw-hr.		
	1914	1913	Per Cent Increase	1914	1913	Per Cent Increase
March	$235,542	$215,457	9.3	6,516,087	5,880,666	10.9
April	250,881	222,646	13.0	7,598,351	6,749,188	12.7

four of these show increases generally confirming the percentages given above. The fact that the fifth company—the largest—reports a falling off in both gross sales and station output shows that the central-station growth is broken here and there by exceptional cases, where, either through reduced rates, adverse municipal action, depression of the local industries or any other of a number of causes, the present year shows some recession upon 1913. Between them these five additional companies report gross earnings of $119,942 for April, 1914, against $116,647 for April, 1913, and an output of 4,775,385 kw-hr. against 5,263,103 kw-hr. The West North Central States include Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska and Kansas; and returns from some nine companies in this area indicate that gross earnings from the sale of energy increased from $607,427 in April, 1913, to $755,960 in April, 1914, or about 24.5 per cent; while output increased from 45,743,132 kw-hr. to 64,062,758 kw-hr., or

at a rate of 40 per cent. On the basis of energy output these companies are handling over 60 per cent of the entire central-station business in the West North Central territory. It should be mentioned that the returns for one city represent a large percentage of the aggregate for this area. The returns at least betoken a very healthy condition in the city of St. Louis and its surrounding territory, which is more than sufficient to offset certain decreases which have been reported to the *Electrical World* from other Missouri properties. Table III presents comparative data for March and April for five companies in the West North Central belt which seem to be typical; and since for March the *Electrical World* reported 9 and 12 per cent as the probable rates of increase for earnings and output, respectively, for the whole of these seven states, it is likely that for April the values are somewhat higher and may be placed at more than 13 per cent on both the earnings and the output. The East South Central States include Kentucky, Alabama, Tennessee and Mississippi, and returns from four companies in this area show that gross earnings increased from $116,301 in April, 1913, to $132,379 in April, 1914, or at a rate of 13.8 per cent, while output increased from 5,623,127 kw-hr. to 6,151,581 kw-hr., or at a rate of 9.3 per cent. On the basis of output these companies represent only one-fourth of the central-station industry in the East South Central territory, but the returns for April check rather closely with those for March, which covered a larger portion of the total. For that month the estimated rates of increase were 14 on earnings and 10.1 on output. April returns from the West South Central group (Louisiana, Arkansas, Texas and Oklahoma) are more satisfactory than the March returns from the same group. For that month the *Electrical World* estimated an increase of 4.8 per cent on earnings and 6.2 on output in 1914 over 1913. The rates for April are certainly higher. Four Stone & Webster subsidiaries which showed less than 4 per cent increase for March on more than $500,000 of gross now show 7.3 per cent for April. Seven other Texas utilities not reporting for March show extremely flattering figures for April, for which month combined earnings were $170,310 for 1914 against $130,419 for 1913, and combined output 5,277,000 kw-hr. against 2,936,000 kw-hr. No decreases are reported by any of the Texas properties making returns to the *Electrical World*, and, since the estimates given for March for the West South Central States were 4.8 and 6.2 on earnings and output, it is probable that for April the ratios are more nearly 8 and 10 per cent, respectively. Summarizing all the foregoing results, it may be said that the condition of the electrical business in the Central States for April of this year, as compared with April of last year, is shown fairly accurately by the following rates of increase: East North Central, gross earnings 16.4, output 14.8; West North Central, 13 and 13; East South Central, 13.8 and 9.3; West South Central, 8 and 10. With the single exception of the East South Central States, from which the returns have not yet been truly representative, all of the values are higher for April than for March.

NEW YORK METAL MARKET PRICES

	June 16			June 23		
Copper	Bid	Asked		Bid	Asked	
Standard spot*	13.25	13.75		13.30	13.70	
	Selling Prices			Selling Prices		
	£	s	d	£	s	d
London, standard spot*	61	10	0	61	0	0
Prime Lake	14.12½	to 14.25		14.00	to 14.25	
Electrolytic	13.80	to 13.90		13.70	to 13.80	
Casting	13.65	to 13.75		13.50	to 13.60	
Copper wire base	15.00	to		14.62½	to 14.75	
Lead		3.90			3.90	
Nickel	40.00	to 45.00		40.00	to 45.00	
Sheet zinc, f.o.b. smelter		7.00			7.00	
Spelter, spot	5.10	to 5.20		5.05	to 5.15	
Tin, spot*	30.00	to 30.25		30.75	to 31.25	
Aluminum:						
Prompt delivery	17.75	to 18.00		17.75	to 18.00	
Future	17.75	to 18.00		17.75	to 18.00	

***OLD METALS**

Heavy copper and wire	12.62½	12.87½
Brass, heavy	8.50	8.62½
Brass, light	7.37½	7.50
Lead, heavy	3.70	3.75
Zinc, scrap	4.00	4.15

***COPPER EXPORTS**

Total tons to June 23 27,747

*From daily transactions on the New York Metal Exchange.

Corporate and Financial

Easton Consolidated Electric Company Dividends.—The Easton Consolidated Electric Company has announced that hereafter dividends will be paid on $1,500,000 par value instead of the paid-up value of $750,000. In the past the company has paid $30,000 a year in dividends while now it will pay $60,000. With the exception of the directors' shares, the stock is owned by the Lehigh Valley Transit Company.

Havana Electric Railway, Light & Power Company's Annual Report.—The company in its annual report shows gross earnings of $5,417,054, operating expenses of $2,489,832, and therefore net earnings of $2,927,222. After deducting interest and fixed charges, the surplus for the year was $1,848,103. The total surplus to Jan. 1, 1913, was $2,999,-662. The electric-light department showed the following: Gross earnings, $1,497,527; operating expenses (not including first charges), $426,253, or 28.46 per cent of gross earnings. The net earnings were therefore $1,071,274, or 71.54 per cent of the gross earnings. Mr. F. Steinhart, president and general manager, gave a detailed report of the improvements. The company served an estimated population of about 325,000. For new construction $1,649,286 was expended. A contract was made with the Westinghouse Electric & Manufacturing Company for three 12,500-kw turbogenerators with the necessary equipment, and later boilers and superheaters were purchased from the Babcock & Wilcox Company. The building contract for the new power plant was made with the Snare & Triest Company, of New York and Havana. The work is to be completed about Aug. 1, 1914.

San Joaquin Light & Power Corporation.—The special meeting of stockholders of the San Joaquin Light & Power Corporation to approve the issue of $3,500,000 6 per cent prior preference stock has been postponed to June 29. If the issue of this new stock is approved and it can be sold on a satisfactory basis, the company will be in a position to liquidate its floating debt and to complete its program of expansion in the San Joaquin Valley. At the same time the stockholders will be asked to authorize $2,000,000 of either first and refunding bonds or debentures. These, however, will not be issued provided there is a satisfactory market for the prior preference stock. The proceeds will be used to pay that portion of the floating debt which cannot be paid from the present bills and accounts receivable and other funds, and to provide adequate working capital for the future. The company had to contend with a dry season in 1913 because it could not use its reservoir in the Crane Valley. As a result it had to buy energy, operate an expensive steam plant, and at a high cost rapidly push the work at Tule River. This made unduly high expenses, which, now that the Tule River project is completed, in the future will be considerably less. The *Electrical World* of Jan. 10, 1914, gave an account of some of the new developments of the company. The financial conditions of 1913 made it impossible for the company to market its first and refunding bonds, and it authorized a two-year note issue secured by the deposit of $4,000 bonds for each $3,000 of notes issued. Of these notes, $1,054,000 were sold. It is to care for these notes, for other floating debts and for other corporate requirements that it is proposed to issue the prior preference stock.

Annual Statement of the Western Canada Power Company, Ltd.—In the annual report to stockholders President C. H. Cahan gives the following information as to present condition and future developments of the Western Canada Power Company, Ltd. At Stave Falls the company has a power house designed for four 9000-kw units, two of which are in commission and the other two contracted for, one to be installed this summer and the other in 1914. During 1913 considerable work was done on the dams and the foundations for the power-house extension were excavated. During 1914 and 1915 this work will be rushed to its completion. To utilize the 130-ft. fall from the tailrace of the Stave Falls power house to tidewater the company had proposed to build one power house. It has since abandoned that plan in favor of two power houses, each for 65-ft. head. In so doing the initial expenditure will be far less for the installation of the first unit. The preliminary designs and

estimates show that this can be done at a cost of from $55 to $60 per hp of maximum demand. For transmission the company owns 33 miles of 60,000-volt steel-tower transmission line, about 22 miles of 60,000-volt modern pole transmission line, a system of 12,000-volt and 2000-volt distributing lines covering a district 50 miles long by 10 miles wide, and a receiving station at Ardley providing for 18,000 kw of transformer capacity. During 1913 55,000,000 kw-hr. was generated, of which 20,000,000 kw-hr. was supplied to the Puget Sound Traction, Light & Power Company, 18,000,000 to the British Columbia Electric Railway Company, and 12,000,000 to the company's own distributing system. During the winter of 1914-15 it is estimated that the demand will be from 16,500 kw to 21,000 kw; 48,196,000 kw-hr. was sold in 1913, realizing a revenue of $293,697. The annual income from lighting and motor service now averages approximately $50 per kw of maximum demand.

Duquesne Light Company of Pittsburgh.—The annual report issued to stockholders by the Philadelphia Company, of Pittsburgh, contains a report of the subsidiary Duquesne Light Company. President James D. Callery of the latter company says that during the year the power plants have been so successfully operated as to furnish better service than ever before, although none of the new 18,000-kva turbo-generators being installed at Brunot Island was in use. One of these units was run under preliminary tests during March, 1914. The new installation at the Brunot Island power plant is going on rapidly and the second turbo-generator is expected to be in operation within a short time. The other two turbo-generators, together with boilers, condensers, piping, coal dock, etc., are expected to be completed during the coming year. At the close of the year the company had in force 43,097 contracts, an increase during the year of 6299, representing an increased power load of 17,758 hp, and also an increased load of 6025 kw for lighting, 381 100-watt lamps and 347 250-watt lamps for municipal lighting, and 135 new signs, using 25,026 4-cp lamps. During the ensuing year it is expected that a number of the company's smaller plants that have been operated during the past year will be shut down and service furnished from the new plant at Brunot Island. For the past fifteen months the company has supplied electric current to the Pittsburgh Railways for the operation of its entire system, and through a most severe winter there were but few outages and the service was considered satisfactory. A comprehensive study has been made of the total power requirements in the Pittsburgh district and a census taken of the individual users of steam power. The severe winter, with an unusually large amount of snow, did not affect the transmission lines to any great extent. A contract was made by the Duquesne Light Company with the Philadelphia Company for the purchase of Brunot Island and the power plant and property thereon for $3,500,000, coincident with which the Philadelphia Company subscribed to an equal amount of Duquesne stock at par. Pending the delivery of the deed for this property the Duquesne Light Company has entered into possession of and is operating that plant, paying a substantial rental therefor to the Philadelphia Company. In the meantime the stock is held for the benefit of, but is not paying dividends to, the Philadelphia Company. Except as to this amount, regular dividends have been paid upon the stock as issued, at the rate of 7 per cent per annum. During the year there were sold $2,500,000 one-year 6 per cent gold notes, dated Feb. 2, 1914, the proceeds of which are to be used for the increase in the power plant at Brunot Island and for betterments, improvements and extensions to the company's other property and plants. The cash on hand March 31, 1914, amounted to $2,543,796, which is estimated to be sufficient to meet all the demands for payments to be made during the year on account of such improvements and provide working capital, and to leave available for dividends that portion thereof derived from earnings. The Pennsylvania Light & Power Company has been operated entirely separate from the Duquesne Light Company. Gross earnings of the Duquesne Light Company in the year were $4,844,223. Total operating expenses were $2,778,043. Taxes amounted to $176,741. Net earnings were $1,889,439. Other income aggregated $283,786, making total income of $2,173,225. Total deductions from income were $608,947, leaving a net income for the year of $1,564,278.

Business Notes

The Traylor Engineering & Manufacturing Company, Allentown, Pa., has made arrangements with Mr. Charles A. Jacobson by which the company will manufacture and sell the Jacobson gas engines. Mr. Jacobson will be associated with the Traylor company.

The Lord Electric Company has delegated its vice-president and chief engineer, Mr. Frederic W. Erickson, to supervise the installation of the mechanical and electrical equipments of the New York State Barge Canal, for which contracts aggregating $2,000,000 were let to this company associated with the MacArthur Brothers Company. The work will involve the construction of sixty-five reinforced-concrete buildings and the installation of twenty-two hydro-electric plants and ten gasoline-electric plants for supplying energy to the motors for the lock gates, valves and capstans and to the arc and incandescent lamps at forty-two canal locks. The work of installation will be completed in May, 1915.

New Industrial Companies

The American Electric Starter Company, of Detroit, Mich., has been organized to take over the Disco Self-Starter Company. The company is capitalized at $250,000. Mansell Hackett is president and general manager.

Becker Brothers, of Chicago, Ill., has been incorporated by Oliver E. Becker, Charles J. Becker and William F. Becker. The company is capitalized at $25,000 and proposes to manufacture and deal in motors, dynamos, electrical apparatus, etc.

The K. H. Sign Manufacturing Company, of Pittsburgh, Pa., has been incorporated with a capital stock of $5,000 to manufacture electric signs and signs of all descriptions. The incorporators are Leon S. Klein, Morton H. Herzog and Eugene B. Strassburger, all of Pittsburgh, Pa.

Trade Publications

Lamp Guards.—Keystone lamp guards are the subject of a folder being sent out by the Electric Service Supplies Company. The details of construction are shown.

Transformer Bells.—The P. R. Manufacturing Company, Detroit, Mich., is mailing a folder referring to its PR transformer bells. This company makes bells for almost every purpose.

Ozone Apparatus.—The Sprague Electric Works of the General Electric Company, 527 West Thirty-fourth Street, New York, illustrate and describe briefly their ozone apparatus in Leaflet No. 853.

Electric Incubators.—Reed's system of electric poultry production is the subject of a sixteen-page pamphlet recently issued by the Electric Manufacturing Company, New Orleans, La. A self-regulating electric incubator is fully described.

Inter-Phones.—The Western Electric Company, 463 West Street, New York, has issued a forty-eight-page catalog referring to its intercommunicating telephone apparatus. Condensed data concerning the various "inter-phone" systems and some wiring diagrams are given.

Exhaust Fans.—Bulletin No. 65 of the Diehl Manufacturing Company, Elizabeth, N. J., relates to motor-driven exhaust fans. Several illustrations of Diehl motors directly connected to exhaust fans show the adaptability of these motors to fans of any style, size or type.

Sight Flow Indicator.—The Richardson-Phenix Company, Milwaukee, Wis., has issued Bulletin No. 57, relating to its standard and minimum flow types of sight flow indicators. Recent improvements include an arrangement that permits the adjustment of the indicator so that it will give an alarm before the liquid stops flowing entirely when the flow drops to some predetermined minimum. This improvement has made the indicator suitable for use on water-cooled transformers.

Personal Mention

Mr. John J. Barlum is the new president of the Detroit (Mich.) public-lighting commission.

Mr. O. A. C. Clarke was recently appointed superintendent of the Geneva (Neb.) Electric Company.

Mr. W. D. Jones has been appointed superintendent of the Phoenix Water Power Company, of Phoenixville, Pa.

Mr. C. L. Howse, assistant to Mr. E. I. Sifton, manager of the Hamilton (Ont.) Hydroelectric Department, has been appointed chief of the electrical and waterworks system in Peterboro, Ont.

Mr. F. F. Funk, of Columbus, Ohio, has been appointed by the Youngstown (Ohio) Consolidated Gas & Electric Company to succeed Mr. W. H. Acker, electrical engineer, who recently resigned.

Mr. Edward Hendley has been appointed manager at Litchfield, Ill., of the Southern Illinois Light & Power Company, to fill the position made vacant by the resignation of Mr. W. E. Peach.

Mr. Henry E. Longwell, formerly consulting engineer for the Westinghouse Machine Company, Pittsburgh, Pa., is now general manager of the Westinghouse Air Spring Company, New Haven, Conn.

Mr. Gerard Swope, vice-president and general sales manager of the Western Electric Company, sailed from New York for Europe on board the steamship *Imperator*. Mr. Swope will be absent two months.

Mr. Walter C. Fish, general manager of the Lynn (Mass.) plant of the General Electric Company, was tendered a dinner by his associates, June 13, to mark the twentieth anniversary of his service with the company.

Mr. N. P. Zech has resigned as assistant to the general auditor of H. M. Byllesby & Company, Chicago, to become treasurer and general auditor of the Atlantic Gas & Electric Company, with headquarters in New York City.

Mr. W. H. Acker, who recently resigned as electrical engineer for the Youngstown (Ohio) Consolidated Gas & Electric Company, has gone to Pittsburgh as transmission engineer of the West Penn Traction Company.

Miss Louise B. Krause, librarian for H. M. Byllesby & Company, has been elected president of the Chicago Library Club, an organization with 275 members. Miss Krause attended the recent annual meeting of the American Library Association at Washington, D. C.

Mr. H. Scholey, of the firm of Scholey & Company, Ltd., London, who represent a number of American electric-railway and lighting specialties in England, is paying a visit to the United States. For a time Mr. Scholey's address will be the Engineers' Club, New York City.

Mr. E. M. Scofield, president of the Scofield Engineering Company, Philadelphia, has been appointed vice-president of the Texas Southern Electric Company, which is being financed by Warner, Tucker & Company, of Boston, for owning and operating public utilities in southern Texas.

Mr. M. R. Hutchinson, who has been associated with Mr. Thomas A. Edison for the past five years, received the degree of doctor of philosophy from the Society of Jesus at Spring Hill College, Spring Hill, Mobile, Ala., on June 17. He attended Spring Hill College in the early nineties and this year delivered the baccalaureate sermon.

Mr. Arthur Williams, of the New York Edison Company, has been appointed vice-chairman of the committee in charge of the display of commercial exhibits to be held at the Grand Central Palace, New York City, Aug. 8 to 29, in connection with the celebration of the tercentenary anniversary of the beginning of the chartered commerce of New York.

Mr. Charles E. Scribner, chief engineer of the Western Electric Company, recently returned to New York on board the new Cunard liner *Aquitania*. While abroad Mr. Scribner appeared in London before a Parliamentary commission to present data regarding the new long-distance, high-speed printing telegraph developed under his supervision. A trial installation has been ordered, and the equipment is now being built.

Mr. H. M. Byllesby, president of H. M. Byllesby & Company, Chicago, in company with Mr. John J. O'Brien, vice-president and general auditor of the same corporation, left Chicago on June 14 for an inspection of the Pacific Coast public utility properties managed by this company. Among the cities to be visited are San Diego, Stockton, Richmond and Eureka, Cal., and Tacoma, Olympia and Everett, Wash. Mr. Otto E. Osthoff, vice-president and chief engineer, and Mr. Elmer Dover, vice-president in charge of the Pacific Coast properties, are now in the West and will accompany Mr. Byllesby on his tour of inspection.

Mr. Frederic W. Erickson, who has been placed in charge of the installation of the mechanical and electrical equipments for the New York State Barge Canal as general manager representing MacArthur Brothers Company and the Lord Electric Company, is vice-president and chief engineer of the latter company. In 1900 Mr. Erickson was associated with the Edison Electric Illuminating Company of Boston and later he was with the wiring department of the New York Edison Company. In 1896 he associated himself with the Lord Electric Company, just then organized. Among his inventions are the Erickson conduit outlet bushing patented in 1896 and the Shawmut bushings for conduits. He is a member of the Engineers' Club, New York, and the Illuminating Engineering Society.

Mr. Thomas A. Wynne, statesman for Indiana of the Jovian Order, is vice-president and engineer of the Indianapolis Light & Heat Company and one of the best known central-station men in the State. He is associated with Mr. C. C. Perry, the president of the Indianapolis Light & Heat Company, one of the pioneers of the electric-service industry in the Middle West. Mr. Wynne has done much high-class engineering work for his company, including the planning of extensions to the main generating station of the company, the use of storage-battery auxiliaries, a well-built distribution system, and one of the best subaqueous coal-storage pits in the United States. He also possesses executive abilty of a high order. Mr. Wynne is an enthusiastic Jovian, and during his incumbency of the office of statesman in Indiana there have been two very successful rejuvenations, both in 1914, the total number of candidates initiated at these two meetings being 274. At the initiation of March 20 the Governor of Indiana and the Mayor of Indianapolis were taken into the order.

THOMAS A. WYNNE

Obituary

Thomas Dolan, for many years president and later chairman of the board of directors of the United Gas Improvement Company, Philadelphia, died of general debility at his home near Torresdale, Pa., June 12, at the age of eighty years. Mr. Dolan organized the Brush Electric Company of New York and Philadelphia and carried out the early electric-arc lighting of Philadelphia and later aided in the organization of the Philadelphia Electric Company in 1899. He was also a director of the Philadelphia Electric Company and of the United Lighting & Heating Company.

James Campbell, chairman of the board of directors of the North American Company, died of pneumonia, June 12, at his summer home, "Indian Field," near Greenwich, Conn. Interment was at St. Louis, where he had lived for a number of years. Mr. Campbell was in his sixty-sixth year. Among the operating companies controlled by the North American Company are the Union Electric Light & Power Company, St. Louis; the United Railways Company, St. Louis; the Milwaukee Electric Railway & Light Company, the Detroit Edison Company, and other associated interests.

Construction

New England

PORTSMOUTH, N. H.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until July 11, for furnishing and installing an after cooler complete, with piping and all accessories, at the central power plant in Portsmouth, N. H. Plans and specifications can be obtained upon application to the bureau or to the commandant of the navy yard named. H. R. Stanford is chief of bureau.

BENNINGTON, VT.—Surveys are now being made for the erection of a high-tension transmission line from North Adams to Bennington for the purpose of connecting this village with the lines of the New England Pwr. Co., which has large generating plants at Brattleboro, Va., and Shelburne Falls, Mass. Distribution in Bennington, it is understood, will be through the local system of the Twin State Gas & El. Co.

FALL RIVER, MASS.—The Fall River El. Lt. Co. has submitted a proposal to the aldermanic committee on lighting offering to install the proposed 4-amp ornamental lamps on South Main, North Main, Pleasant and Morgan Streets, and maintain them until Jan. 1, 1915, free of cost to the city. This would mean an addition of 36 arc lamps.

PITTSFIELD, MASS. — The Common Council has entered into a new contract with the Pittsfield El. Co., whereby new street lamps will be installed from the new union station in West Street to Maplewood Hotel on North Main Street. The committee on street lights has recommended the installation of 51 luminous arc lamps and 110 incandescent lamps.

SOUTHBORO, MASS.—Plans are being considered by the Metropolitan Water and Sewerage Board to establish a hydroelectric plant at the Fayville Dam, a short distance from the Southboro-Framingham town line, similar to the plant erected at Clinton several years ago, at a cost of $125,000.

WORCESTER, MASS.—Plans are being considered, it is reported, by the White & Bagley Co., manufacturer of soaps and oils, for the construction of a new power house. H. P. Bagley is president and treasurer.

Middle Atlantic

AMSTERDAM, N. Y.—The contract for the construction of a power plant for McCleary, Wallin & Crouse, of Amsterdam, manufacturers of rugs, has been awarded to J. W. Bishop, 109 Foster Street, Worcester, Mass. The cost of the plant is estimated at about $85,000.

FLUSHING, N. Y.—Under the new contract with the New York Edison Co. for lighting the streets and public places, the present electric street lamps will be changed to the new nitrogen lamps.

HINSDALE, N. Y.—The Town Board has entered into a contract with the Cattaraugus County Ltg. Co., of Olean, for lighting the streets of the village. The company is planning to erect a transmission line from Olean to Franklinville.

HUDSON, N. Y.—Bids will be received by Miss Mary Hinckley, president of the board of managers of the New York State Training School for Girls, Hudson, N. Y., until July 10, for construction, heating, plumbing and electrical work for Contagious Hospital, also for two horizontal tubular boilers for the New York State Training School for Girls. Drawings and specifications may be consulted and blank forms of proposal obtained at the New State Training School for Girls, Hudson, and at the office of Lewis F. Pilcher, state architect, Capitol, Albany.

LE ROY, N. Y.—The Village Board is considering the question of installing a new street-lighting system. It is proposed to replace the present arc lamps with cluster lamps.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, corner Park Avenue and Fifty-ninth Street, New York, N. Y., until June 29, for additions and repairs to electric equipment in Public Schools 51, 69, 84, 106, 151 and 166, borough of Manhattan. A separate proposal must be submitted for each school.

NEW YORK, N. Y.—Bids will be received by Robert Adamson, fire commissioner, headquarters of the Fire Department, eleventh floor, Municipal Building, New York, until June 29, for furnishing and installing electric-lighting systems and altering gas-lighting systems in quarters of engine companies Nos. 9, 27, 29 and hook and ladder company 6. Blank forms and further information may be obtained at the above office.

ORWELL, N. Y.—Plans and specifications for the construction of a dam on the Salmon River in the town of Orwell by the Salmon River Pwr. Co. have been approved by the Conservation Commission.

ROCKVILLE CENTER, N. Y. — The Board of Village Trustees has purchased for delivery this summer one 500-hp cross-compound 18-in. by 24-in. by 24-in. Ball engine and one Fort Wayne 375-kva, two-phase, 60-cycle, 2300-volt generator. H. C. Mayor is chief engineer.

SOUTHAMPTON, N. Y.—The Suffolk Lt., Ht. & Pwr. Co., of Southampton, has applied to the Public Service Commission for permission to issue $22,500 in bonds.

WATKINS, N. Y.—Within the next six months the managers of the municipal electric-light plant expect to purchase a generator and engine (directly connected) and a generator switchboard panel; also within the next 30 days 60 lamp standards and globes. Charles E. Dennis is superintendent.

WAYLAND, N. Y.—Within the next three months the Wayland El. Lt. & Pwr. Co. expects to erect 3 miles of transmission lines and to purchase one 100-kw, three-phase generator directly connected to engine and switchboard panel. John Kimmel is manager.

DERRY, PA.—The Council is considering replacing the present street lamps with tungsten lamps. The West Penn El. Co., of Pittsburgh, furnishes electrical service in Derry.

HERSHEY, PA.—The contract for the power house of the Hershey Transit Co., to be located near Gingrich's Meeting House, about 2½ miles from Lebanon, has been awarded to Stohler Brothers, of Lebanon. The building will be 38 ft. by 28 ft., and will supply electricity to operate the cars between Lebanon and Mount Pleasant.

PHILADELPHIA, PA.—Applications have been filed with the Secretary of State for charters for the Equitable El. Pwr. Co. and the Pennsylvania El. Pwr. Co., both to operate in Philadelphia. Each company is capitalized at $10,000, and the incorporators are M. P. Quinn, John Rapp and Charles Doebler, of Philadelphia. The Equitable El. Pwr. Co. has submitted a bid for lighting the Second District, covering Germantown and the Northeast, contingent on being granted a franchise. The Philadelphia El. Pwr. Co. proposes to furnish water and water-power for commercial and manufacturing purposes in Philadelphia.

BAYONNE, N. J.—The Council has passed a resolution calling for a referendum on the installation of a municipal electric-light plant, to be submitted to the voters at the next election.

BOONTON, N. J.—The Board of Utility Commissioners has granted the Boonton El. Co. permission to issue $15,000 in bonds.

HACKENSACK, N. J.—Bids will be received by a committee of the Board of Chosen Freeholders of Bergen County, at the office of clerk of board, Court House, Hackensack, until July 1, for installing a new lighting system on the Anderson and Court Street bridges over the Hackensack River, Hackensack. Plans and specifications can be examined and necessary information obtained at the office of the county engineer, Court House, Hackensack.

NEWARK, N. J.—Preliminary work has been started by the Public Ser. El. Co. on the construction of a large electric generating station at Point-No-Point on the Passaic River. Plans for the initial installation provide for 50,000 kw, with provision for an ultimate output of 150,000 kw. The station will be known as the Essex station, and about $2,000,000 will be expended on it within a year.

NEW HOPE, N. J.—Plans are being considered by the Bucks County El. Co., of Newtown, Pa., for the installation of an electric-lighting system in New Hope. An ordinance passed by the Council provides that construction must begin within a year.

PARK RIDGE, N. J.—Within the next six months the Electric Light Commission expects to erect 100 chestnut poles (with arms and equipment) to replace old poles. E. Vernon Smith is superintendent.

PENNINGTON, N. J.—The Hopewell Township committee is negotiating with the Public Ser. El. Co. for the installation of an electric-lighting system on the Pennington Road.

PERTH AMBOY, N. J.—The Board of Water Commissioners has appropriated $100,000 for new pumping equipment and extensions to the water-works system and Runyon pumping station.

RED BANK, N. J.—Municipal ownership of the electric-light system is under consideration by the Borough Council. The present contract for street lighting with the Public Ser. El. Co. expires next January.

WOODSTOWN, N. J.—The El. Co. of New Jersey, which furnishes electricity in Salem, Glassboro, Grenloch and several other towns, is negotiating for the purchase of the electric system of the Woodstown Ice & Cold Storage Co., of Woodstown.

CUMBERLAND, MD.—The installation of an ornamental street-lighting system on Baltimore Street is under consideration.

CAMBRIDGE, MD.—The City Council is reported to have granted Martin W. Smith, John Burgess, Jr., and Robert B. Porter a franchise to furnish electricity in Cambridge.

COVINGTON, VA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 14 for construction complete, including mechanical equipment, interior lighting fixtures and approaches, of the United States post office at Covington. Drawings and specifications may be obtained from the custodian of site at Covington, or from the above office. O. Wenderoth is supervising architect.

WASHINGTON, D. C.—Bids will be received at the office of the Commissioners of the District of Columbia, Room 509, District Building, Washington, D. C., until July 14 for furnishing electrically operated centrifugal sewage pumps for use in the sewer department of the city. Specifications and forms of proposal may be obtained from the purchasing officer, Room 320, District Building, Washington.

WASHINGTON, D. C.—A bill authorizing an expenditure of $15,021,600 for a hydroelectric development on the Potomac River, a short distance above the city of Washington, as an amendment to the river and harbor bill has recently been introduced in the Senate by Senator Norris, of Nebraska. The proposed project includes the construction of a 115-ft. dam and a hydroelectric power plant at Chain Bridge. The dam, it is said, would create a dam 9 miles long, reaching back to Great Falls. It is estimated that about 99,000 hp could be developed.

North Central

COLDWATER, MICH.—Bids will be received by J. B. Montgomery, superintendent of Board of Control of the Michigan State Public School, Coldwater, until July 7 for electrical work in connection with the new buildings to be erected. Edwyn A. Boyd, of Lansing, is architect.

CRYSTAL FALLS, MICH.—The Council it is reported, has accepted the offer of the Electrical Engineering Co., of Minneapolis, Minn., to take charge of the installation of a new generator and water-wheel at the municipal power plant. The cost of the improvements is estimated at about $6,000.

AKRON, OHIO.—Bids will be received at the office of the director of public service, Akron, until July 14, for construction of buildings for garbage reduction works, as follows: (A) excavation, embankment and concrete work; (B) brick work, cut stone work, steel work, carpenter work, electrical work, and mill work, metal windows, etc.; (C) rolling steel doors, metal lockers, castings, industrial equipment and loading conveyor; (D) boilers and steam piping; (E) brick stack and appurtenances; (F) feed-water heater and regulator, boiler-feed pumps, drain pump and draft regulator; (G) railroad track and appurtenances. Bids will be received collectively or separately. Copies of plans and specifications, proposal forms, etc., may be seen at the office of the director of public service, City Hall, Akron, or at the office of W. Winthrop Pratt, Hippodrome Building, Cleveland, or may be obtained upon deposit of $20, to be refunded upon return of same.

ATHENS, OHIO.—The Ohio El. Pwr. Co., which is erecting a power plant in Floodwood, has submitted a proposal to the City Council offering to purchase the municipal electric-light plant. The Council is contemplating calling an election to vote on the proposal to issue bonds for improvements to the municipal plant.

CANTON, OHIO.—The Canton El. Co., has asked the City Council for an extension of its street-lighting contract with the city, which expires in two years, in return for which the company agrees to place its wires underground.

CHICAGO JUNCTION, OHIO.—Within the next 30 days the Board of Trustees of Public Affairs expects to purchase second-hand equipment as follows: One 120-kw, single-phase, 125-cycle or 133-cycle, 1100-volt alternator, and one 150-hp engine to drive same; one new or second-hand heater having a capacity of 300 hp.

CINCINNATI, OHIO.—Steps have been taken by the Main Street Merchants' Association to obtain a uniform lighting system on Main Street.

COLUMBUS, OHIO.—Plans are being considered by the merchants and property holders on the four blocks facing the Statehouse for lighting the State Capitol dome, at a cost of about $5,000. The State will maintain the service after it is installed.

EATON, OHIO.—The Eaton Ltg. Co. has applied to the City Council for a franchise for lighting the streets of the city for a period of ten years. The company proposes to replace the present 40-cp lamps in the business section of the city with 100-cp lamps.

LOGAN, OHIO.—The Ohio Lt. & Pwr. Co. has begun work on the reconstruction of its wires in this city, taking them from the streets wherever possible and placing them in alleys. The right-of-way for a transmission line to Shawnee has been secured. The old electric-light station will be used as a substation to transform energy transmitted from Thornsport for local distribution; a complete circuit of the high-tension line will be erected from Thornsport via Lancaster to Logan, thence to New Straitsville, Shawnee, New Lexington, Somerset and back to Thornsport, where this wire intersects with the lead wires from Newark.

MANSFIELD, OHIO.—The date for receiving bids for furnishing electric street lamps for the city of Mansfield has been changed from July 1 to Aug. 1. For details see proposal columns.

OAK HARBOR, OHIO.—Arrangements have been made by the village of Oak Harbor to purchase energy to operate the municipal electric system. The generating station will be closed down about Aug. 1 and the entire equipment of the plant, including boiler, engine, arc and alternating-current generators, and all accessories, will be sold to the highest bidder. For details see proposal columns. Louis L. Carsten is clerk.

SANDUSKY, OHIO.—The City Council is considering the installation of an ornamental street-lighting system. John J. Molter is director of public service.

SPRINGFIELD, OHIO.—Plans have been prepared by Schenck & Williams, of Dayton, architects, for the construction of a large building in Springfield for E. L. Shuey, of Dayton. The building will be equipped with electric freight and passenger elevators and power equipment for the joint use of manufacturers occupying the building. The cost of building and equipment is estimated at $150,000.

WARREN, OHIO.—The Western Reserve Steel Co., which is erecting a large steel plant in Warren, has contracted with the Trumbull Pub. Ser. Co. for 6000 kw per year to operate its plant, which will be equipped with electrically operated machinery throughout. The Trumbull company, it is reported, will remodel its generating station and install new boilers, turbines, etc.

WYOMING, OHIO.—Plans are being prepared for the installation of a municipal electric-light plant in Wyoming.

BURLINGTON, KY.—The Walton El. Lt. Co. is installing an electric-light plant in Burlington. H. W. Mayfield is interested in the project.

LOUISVILLE, KY.—The contract for the construction of the new Boys' High School Building in Louisville has been awarded to Bailey & Koerner, Walker Building, Louisville. Bids, it is understood, will soon be asked for electrical work, which will include vacuum-cleaner service, clock service, telephone and lighting systems, to cost from $3,000 to $10,000.

LOUISVILLE, KY.—The Lee Cook Mfg. Co., of Louisville, is in the market for the following second-hand equipment (to be in first class condition): One 300-hp or two 200-hp water-tube boilers, capable of 150 lb. pressure; two standard two-stage high-duty air compressors with 700 ft. free air capacity; one 10-kw to 15-kw direct-current generator directly connected to engine, either 110 volts or 220 volts, the latter preferred; one standard gage saddle-tank locomotive capable of 140 lb. steam pressure with about 12-in. cylinders; one 600-hp wet vacuum pump, duplex and flywheel type preferred; one standard gage locomotive crane with approximately 30-ft. boom and 10-ton capacity. C. Lee Cook is president.

BROWNSTOWN, IND.—The plant and holdings of the Brownstown Wtr. & Lt. Co. have been purchased by E. Darrow, former general manager of the Merchants' Ht. & Lt. Co. of Indianapolis, and Robert M. Cass, former assistant general manager of the Indianapolis Lt. & Ht. Co., of Indianapolis. The new owners contemplate revamping plant, establishing a day power service and the installation of an ice plant in conjunction with the water and light plant.

GOSHEN, IND.—The Hawks El. Co., of Goshen, has been granted permission by the Indiana Public Service Commission to extend its transmission lines to Waterford and New Paris.

INDIANAPOLIS, IND.—The City Council has ratified the contract between the city of Indianapolis and the Merchants' Ht. & Lt. Co., of Indianapolis, for lighting the city.

TELL CITY, IND.—The City Council has voted to issue bonds to the amount of $17,000 for remodeling and improving the municipal electric-light plant.

GLASFORD, ILL.—The Town Board has entered into a contract with the Canton Gas & El. Lt. Co., of Canton, to light the streets of the town for a period of five years. The contract calls for 25 tungsten lamps.

LINCOLN, ILL.—Funds have been provided by the Commercial Association and the City Council for changing the street-lighting circuit, so as to provide for the installation of cluster lamps. About $1,600 will be expended.

STERLING, ILL.—The contract for the installation of the ornamental-lighting system has been awarded to the Electric Construction Co., of Rock Island, at $7,997. The contract provides for 82 lamp standards and also for equipping transforming room in the city hall building.

DEER PARK, WIS.—The Village Council has decided to erect lamps at all corners of the platted part of the village. On Main Street 80-cp lamps will be used.

DELAVAN, WIS.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 16 for construction complete, including mechanical equipment, interior lighting fixtures and approaches, of the United States post office at Delavan. Drawings and specifications may be obtained from the above office or from the custodian of site at Delavan. O. Wenderoth is supervising architect.

WASHBURN, WIS.—Plans are being considered, it is reported, to equip the coal docks of the Northwestern Fuel Co. in Washburn with electrically operated apparatus.

CLARA CITY, MINN.—The Village Council has entered into a contract with the Montevideo Lt. & Pwr. Co., of Montevideo, to establish an electric-lighting system in Clara City.

DES MOINES, IA.—The City Council, it is reported, is contemplating replacing the present Welsbach gas lamps with a municipal electric-lighting system.

ESTHERVILLE, IA.—At an election held recently bonds to the amount of $60,000 were voted for improvements to the municipal electric-light plant and waterworks system.

HUME, MO.—The proposal to grant a franchise for the installation of an electric-lighting system will soon be submitted to the voters.

NEVADA, MO.—The installation of a municipal electric-light plant in Nevada is under consideration. At a special election held June 18 the proposal to renew the street-lighting contract with H. R. Gunn for one year was defeated. As a result of the election the city will be without street-lighting service after Oct. 1, when the present contract expires.

PALMYRA, MO.—The City Council has voted to call an election to submit the proposal to issue $26,000 in bonds for improvements to the municipal electric-light and water plants. Of the proceeds about $8,000 will be used for the electric-light plant.

SHELDON, MO.—A special election will be held June 30 to vote on the proposal to enter into a contract with G. B. Beeny, owner of the local electric-light plant, to furnish the city with electricity for a period of three years. The proposal to install 28 new electric street lamps will also be submitted to the voters.

BOWBELLS, N. D.—The Kenmare Lt. & Pwr. Co., controlled by the National Briquetting Co., of Kenmare, has submitted a proposal to the town of Bowbells, offering to furnish electricity for lighting the town.

SHERWOOD, N. D.—Work will soon begin on the construction of an electric-light plant in Sherwood. C. H. Butke, of Sherwood, is reported interested in the project.

ALEXANDRIA, S. D.—Plans are being considered for the installation of a municipal electric-light plant in Alexandria, bids for construction of which will be received about Aug. 1. The plant will probably be driven by an oil engine. As yet an engineer has not been engaged. H. M. Schumacher is city auditor.

DECATUR, NEB.—The contract for building an addition to the municipal power house has been awarded to Robert Burns.

ST. PAUL, NEB.—The City Council is considering the question of establishing a municipal electric-light plant in St. Paul.

LA CROSSE, KAN.—An election will be held in July to submit to the voters the proposition to issue $12,000 in bonds, the proceeds to be used for extensions to the street-lighting system and improvements to the municipal electric-light plant.

LARNED, KAN.—Estimates submitted by Worley & Black, Reliance Building, Kansas City, Mo., consulting engineers, place the cost of installing a municipal electric-light plant in Larned at $64,100. The plans provide for a steam generating plant and an ornamental street-lighting system, consisting of 70 lamp standards. Bonds to the amount of $90,000 were recently voted to establish a municipal plant.

LEAVENWORTH, KAN.—Application has been made to the City Council by W. J. Squires for a franchise to construct and operate an electric-light plant in Leavenworth. A special election will be held in July to submit the proposal to the voters.

MANHATTAN, KAN.—Negotiations are under way between the City Commissioners and the Manhattan Ice, Lt. & Pwr. Co., with a view of purchasing the plant of the latter to be owned and operated by the municipality.

PITTSBURG, KAN.—Plans have been completed for the installation of an ornamental street-lighting system in the business district.

ROBINSON, KAN.—The City Council has passed an ordinance granting C. T. Stocking, of Hiawatha, a franchise to construct and operate an electric-lighting system in Robinson. Charles Pirkey is clerk.

Southern States

BETHEL, N. C.—Contracts have been awarded for equipment and construction of the proposed municipal electric-light plant in Bethel, to cost about $6,000.

GASTONIA, N. C.—Within the next four months the Board of Public Works expects to purchase lamp-posts for the business district. H. Rutter is superintendent.

WADESBORO, N. C.—Within the next two months the Yadkin River Pwr. Co., of Wadesboro, expects to erect about 2 miles of 2300-volt feeder and series arc-lamp line. P. N. Pittenger is local manager.

WAKE FOREST, N. C.—Within the next 30 days the town of Wake Forest expects to purchase the following equipment for the municipal electric-light plant: One 75-kw, three-phase, 60-cycle, 2300-volt generator, a 150-horizontal-return tubular boiler, 75-ft. smokestack and a 125-hp engine for direct connection to generator. J. L. Bullard is superintendent.

COLUMBUS, GA.—The Columbus Pwr. Co., it is reported, is planning to install an additional 5000-kw generating unit at its Goat Rock station.

MOULTRIE, GA.—Bids will be received by the city of Moultrie until July 1 for the installation of an ornamental street lighting system. The plans provide for 100 lamp standards. R. J. Corbett is chairman of purchasing committee.

COOKEVILLE, TENN.—Preparations are being made by the Gainesboro Tel. Co. (main office at Cookeville) for improvements to its system, involving an expenditure of about $40,000. Copper circuits will be erected in Tennessee from Cookeville to Sparta, Cookeville via Monterey and Crossville to Rockwood; in Kentucky: Monticello via Burnside and Somerset to Danville, Glasgow to Burkesville, at a cost of $20,000.

PULASKI, TENN.—The Board of Aldermen has decided to remove the new municipal electric-light plant from the City Hall to a site near the depot. The old electric plant (which is not in use) will be moved to the same building, and will be used during the removal of the other plant.

SPRINGFIELD, TENN.—The City Commissioners, it is reported, are contemplating improvements to the municipal electric-light plant.

MORRILLTON, ARK.—The Seven Cities Co., of St. Louis, it is reported, is negotiating for the electric-light and water plants in Morrillton and Atkins. The Seven Cities Co. has increased its capital stock from $250,000 to $500,000.

ABITA SPRINGS, LA.—The contract for lighting the streets of the city, it is reported, will be awarded to James Rauch and Emile Aubert.

NEW ORLEANS, LA.—Bids will be received by George G. Earl, general superindentent sewerage and water board, until July 30 for wire and valves for the drainage system.

GUTHRIE, OKLA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 18, for the installation of an electric passenger elevator and a hydraulic lift, etc., in the United States post office and court house in Guthrie. For details see proposal columns.

POND CREEK, OKLA.—Arrangements are being made for reconstruction of municipal electric-light plant and waterworks system, including the installation of a 50-hp oil engine, one 40-kw generator, two centrifugal pumps, two 15-hp, single-phase motors, four transformers, 1½ miles three-wire transmission line, switchboard and instruments. C. C. Shepard is superintendent.

BEEVILLE, TEX.—The plant and holdings of the Beeville Pwr. & Lt. Co. are reported to have been taken over by the Texas Southern Electrical Co., of Boston, Mass. It is understood that the new owner contemplates improvements to the system.

DALLAS, TEX.—Application has been made to the Commissioners' Court of Dallas County by the Rev. O. S. Thomas, commissioner for the Southern Methodist University, on behalf of the institution, for a franchise to construct a street railway on Atkins Avenue to the university addition.

DALLAS, TEX.—Plans are being prepared by Smith & Whitney, of Dallas, for the installation of a municipal lighting plant in the basement of the new city building at Main and Harwood Streets, to furnish electricity to light the municipal building, central fire station and the ornamental lighting system on Main, Elm and other streets.

DE LEON, TEX.—The De Leon-Gorman Lt. & Pwr. Co. has decided to install an electric-light plant in Gorman.

KIRVIN, TEX.—The Young Men's Christian Association is considering plans for the installation of an electric-lighting system on Main Street. An electric plant has recently been installed in Kirvin by A. V. Kelley.

TAFT, TEX.—The electric plant of the Taft Gin & Oil Co., recently destroyed by fire, it is reported, will be rebuilt.

Pacific States

RIDGEFIELD, WASH.—The City Council has granted J. H. Cunningham, of Portland, Ore., franchises to install and operate an electric-light plant and water-works system in Ridgefield.

SEATTLE, WASH.—The City Council has passed the ordinance authorizing the installation of cluster lamps on Madison, Marion and Columbia Streets, west of First Avenue. Bids for material and installation of same will soon be asked by the Board of Public Works. A. L. Valentine is chairman.

SPOKANE, WASH.—Harry Flood, president of the Trustee Co., has filed with the city clerk the acceptance of the franchise granted to the company by the City Council on April 6 to construct and operate an underground system to furnish steam or hot-water heating and electricity for lamps and motors.

EUGENE, ORE.—Bids will soon be received by the city clerk for the installation of cluster lamps on Olive Street (electrical equipment only), between Fifth and Ninth Avenues, and on Eighth Avenue, between Willamette and Lincoln Streets. Iron posts will be furnished by the Eugene Iron Works. The cost of the system is estimated at about $7,500.

MAPLETON, ORE.—The County Court has granted Richard H. Clow, of Mapleton, a franchise to erect and maintain electric transmission lines on the streets in Mapleton and county roads adjacent.

NEHALEM, ORE.—At an election to be held July 15 the proposal to issue $12,500 in bonds for the purchase of the water system and construction of reservoir and installation of an electric-light plant will be submitted to the voters.

RIDDLE, ORE.—The Sugar Pine Box Co., of Riddle, is planning to install an electric-light plant to furnish electricity to light the town. The equipment will include a Fairbanks-Morse gas engine and a direct-current generator; about 4 miles of wire and fir poles will be used for the distributing system; 45 meters and about 600 incandescent lamps will be required. W. W. Vaughn, of Riddle, is engineer in charge.

PLACERVILLE, CAL.—Plans are under way for enlarging and improving the local system of the Western States Gas & El. Co., at a cost of about $50,000. An additional generator will be installed and the flume enlarged.

SACRAMENTO, CAL.—The installation of an electric generating plant in the basement of the Capitol will be recommended by George G. Radcliff, superintendent of buildings and grounds, to furnish electricity for lamps and motors for the Capitol, state printing office and the Governor's mansion.

SAN BERNADINO, CAL.—The Board of County Supervisors has granted the Southern California Ed. Co., of Los Angeles, permission to erect transmission lines along certain highways in San Bernardino County.

SAN FRANCISCO, CAL.—The Board of Public Works has awarded the contract for furnishing and installing overhead electrical conductors for the Municipal Railway to H. S. Tuttle, at $36,245.

SAN FRANCISCO, CAL.—The lighting committee of the Board of Supervisors has recommended that the contract for supplying electricity for lighting the City Hall, Hall of Justice, pumping station at Drumm and Commercial Streets, the corporation yard at 313 Francisco Street, and corporation yard at Sixteenth and Harrison Streets, to be awarded to the City El. Co., at 2¼ cents per kw-hr.

PROVO, UTAH.—The Southern Utah Pwr. Co., recently incorporated under the laws of the State of Delaware, has filed a certificate of incorporation with the county clerk. The company is capitalized at $600,000 and proposes to generate and transmit electricity for lamps, heaters and motors. It is understood that the company will take over the holdings of L. L. Nunn in Sevier County and operate and extend the same.

SALINA, UTAH.—Application has been filed in the office of the State Engineer by William Johnson, of Richfield, for permission to construct a concrete weir in the Sevier River, north of Salina, to divert 400 second-ft. of water into a power canal, which will be 19,000 ft. long.

FORT BENTON, MONT.—The City Council has passed an ordinance providing for an issue of $17,000 in bonds for the purchase of an electric-light plant.

FORT BENTON, MONT.—The Benton El. Lt. Co., of Fort Benton, has recently installed one 30-hp electrically driven pump. George L. Overfield is superintendent.

GREAT FALLS, MONT.—The Great Falls Pwr. Co. has applied for permission to erect transmission and telephone lines across Helena National forests.

CASPER, WYO.—The Netrona County El. Co., of Casper, is contemplating a bond issue, the proceeds to be used for improvements. Correspondence is invited with bond houses that may be interested. J. A. Ward is general manager.

RIVERTON, WYO.—The Town Council has granted P. B. Dykeman, of Riverton, a franchise to construct and operate an electric-light plant here.

GLENWOOD SPRINGS, COL.—At an election held recently the proposal to issue $110,000 in bonds, the proceeds to be used to purchase the plant of the Glenwood, to be owned and operated by the municipality, was carried.

LAS ANIMAS, COL.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until July 11, for furnishing and installing four 100-hp water-tube boilers, a fan, and motor, valves, piping and all other accessories in the central power plant, at the United States Naval Hospital, Las Animas. Plans and specifications can be obtained on application to the bureau. H. R. Stanford is chief of bureau.

Canada

EDMONTON, ALTA.—Plans are being prepared by the Wabanun Pwr. Co., of Edmonton, for the construction of a power plant at its mines about 40 miles from here. The plant will have an output of 10,000 kw and will furnish electricity in Edmonton and surrounding territory, within a radius of 100 miles.

LETHBRIDGE, ALTA.—By-laws providing funds amounting to $59,923 for construction of electric plant and machinery and $1,642 for construction of power buildings are being advertised in Lethbridge; also a by-law providing $22,666 for extensions to electric light and power system.

SHOAL LAKE, MAN.—All tenders received May 28 for the installation of a direct-current lighting system with storage batteries were considered too high. New bids will be asked for alternating-current apparatus about July 12. The John Galt Engineering Co., 317 Portage Avenue, Winnipeg, is consulting engineer.

STONY MOUNTAIN, MAN.—A substation to provide electricity for lighting purposes, it is reported, will be erected in Stony Mountain.

WINNIPEG, MAN.—Bids will be received by the city of Winnipeg until June 30 for switchboard and other apparatus for fire-alarm system.

EUGENIA, ONT.—Contracts have been awarded for the construction of a new electric generating station to be built for the Hydro-Electric Power Commission at Eugenia Falls, near Owen Sound, as follows: For dam No. 1, 2000 ft. long and from 40 ft. to 50 ft. high, to the Ambursen Hydraulic Construction Co., of Montreal; dam No. 2 to Hyland, Scribbin & White, of Toronto. Tenders are being received for the necessary hydraulic and electrical equipment, which will be used to develop 4000 hp.

NIAGARA FALLS, ONT.—The Ontario Hydro-Electric Power Commission of Ontario is planning to utilize the waste waters of the new Welland ship canal on the Niagara River, conveying the waters to the Whirlpool, where a generating station will be built. The cost of the undertaking is estimated at $2,000,000. Surveys are now being made under the direction of F. A. Gaby, chief engineer.

STRATFORD, ONT.—Plans have been prepared for the installation of an ornamental street-lighting system in Stratford, for which $22,000 has been appropriated. The plans provide for the erection of 180 steel trolley posts carrying 500-watt nitrogen-filled lamps, maintained by overhead wires. R. H. Myers is secretary of the Stratford light and heat commission.

TAVISTOCK, ONT.—The ratepayers have recently voted in favor of a bylaw providing for the installation of hydroelectric power to be obtained from the Hydro-Electric Power Commission of Ontario.

MONTREAL, QUE.—The Montreal Electrical Commission has applied to the Quebec Public Utilities Commission for approval of plans for further underground conduits.

BELCARRES, SASK.—A small power plant, it is understood, will be installed in connection with the new hotel being erected in Belcarres by J. Dawsey, of Melville, to furnish electricity to light the hotel and the main part of the town; also for street lighting.

REGINA, SASK.—At an election held June 3 the by-law to appropriate $200,000 for extensions to the city electrical department was carried.

WOLSELEY, SASK.—Preparations are being made for improvements to the municipal electric-light plant, consisting of a 30-kw, 60-cycle Westinghouse generator, Westinghouse switchboard, two 4-kva, two-phase transformers and one 5-kva, three-phase transformer, 45 35-ft. poles, No. 6 double-braided weather-proof wire, eight Westinghouse indoor-type lightning arresters. Charles Stengel is manager.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing office, the Panama Canal, Washington, D. C., until July 6, for furnishing switches, switch stands, steel billets, steel cable, brass rod, copper bar, sheet copper, motor-driven woodworking shaper, motor-driven sailmaker's sewing machine, etc. Blanks and general information relating to this circular (No. 858) may be obtained from the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Maj. F. C. Boggs is general purchasing officer.

New Incorporations

WASHINGTON, D. C.—The New Arcade Co. has been chartered with a capital stock of $150,000 to acquire and operate electric-light plants.

WESTBROOK, MINN.—The El. Lt. & Pwr. Co. has been chartered with a capital stock of $10,000. The incorporators are K. Kreuger, John E. Villa, P. G. Hiebert

MEDIANA, OHIO.—The Phoenix El. Co. has been incorporated with a capital stock of $25,000 by F. W. Woods, L. F. Carver, R. G. Strong and others.

NOWATA, OKLA.—The Nowata El. Lt. Co. has been incorporated with a capital stock of $30,000 by E. B. Lawson, Frank Hancock and D. B. Howell, of Nowata.

DENMARK, S. C.—The Denmark Lt. & Pwr. Co. has been chartered with a capital stock of $10,000 by C. D. Campbell, T. M. Phifer and Frank G. Tompkins, all of Columbia, S. C. The company proposes to supply electricity in Denmark. T. M. Phifer is president.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JUNE 16, 1914.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York, N. Y.]

1,099,909. Apparatus for Testing Storage-Battery Circuits: C. E. Beach, Binghamton, N. Y. App. filed Sept. 24, 1910. For switching in the testing instruments and protecting them from undue current.

1,099,915. Key-Plunger Unit; E. B. Craft, Hackensack, N. J. App. filed Sept. 2, 1911. Contact springs mounted in a frame so as to be all removable as a unit.

1,099,934. Coating of Flexible Objects of Organic Origin with Metals; R. Rafn and G. E. Schmidmer, Nuremberg, Germany. App. filed Oct. 16, 1912. Articles passed in vacuum in proximity to suitable metal electrodes.

1,099,960. Electric Converter; C. I. Zimmerman (deceased), Niagara Falls, N. Y. App. filed Oct. 17, 1906. One or more asymmetric conductors, together with means for accumulating a very appreciable electrostatic charge.

1,099,968. Protective Device; E. E. F. Creighton, Schenectady, N. Y. App. filed Feb. 10, 1914. Electrolytic lightning arrester of the aluminum-cell type.

1,099,986. Outlet or Junction Box; G. A. Lutz, New York, N. Y., and C. C. Sibley, Perth Amboy, N. Y. App. filed July 19, 1906. Detachable covers to the outlet openings in the box.

1,099,987. Outlet or Junction Box; G. A. Lutz, Plainfield, N. J. App. filed Dec. 17, 1910. Special closures to the outlet openings.

1,099,988. Electric Flatiron; C. P. Madsen, Chicago, Ill. App. filed Sept. 26, 1912. Has relatively small conductors with two or more coils in multiple.

1,099,998. Submarine Signaling Apparatus; F. J. Schiessler, Vienna, Austria-Hungary. App. filed May 12, 1909. Includes a clock and wireless receiving mechanism for starting the clock.

1,099,999. Electrical Heater; W. S. Sheppard, Colorado Springs, Col. App. filed July 25, 1913. For use in motor vehicles.

1,100,014. Overhead Contact Shoe for Electric Railways; G. Gibbs, New York, N. Y., and E. R. Hill, East Orange, N. J. App. filed March 26, 1914. Length of the contact shoe is reduced automatically upon a lowering of the pantograph.

1,100,018. Case for Loading Coils; F. B. Jewett, Wyoming, and T. Shaw, Hackensack, N. J. App. filed Nov. 10, 1910. Hermetically sealed and arranged for convenient application to submarine cable.

1,100,037. X-Ray Tube; S. Tousey, New York, N. Y. App. filed Feb. 23, 1911. Utilizes only the direct rays coming from the anticathode.

1,100,116. Testing System for Telephone Party Lines; C. C. Bradbury, Rochester, N. Y. App. filed March 25, 1912. Gives operator a positive indication of the condition of a line being tested.

1,100,117. Electromagnetic Musical Instrument; C. Breed, Philadelphia, Pa. App. filed March 30, 1912. Effects pulsations of the current in the desired phase relation to the vibrations of the piano strings.

1,100,134. Controller; C. A. Jackson, Chicago, Ill. App. filed Nov. 26, 1909. Stopping, starting and reversing control for motors as used in elevator service.

1,100,139. Electric Locomotive with Automatic Cable Reel; W. S. Mayers, Fairmont, W. Va. App. filed Nov. 18, 1906. Has separate reel-driving motor, independent of the propelling motor.

1,100,168. Telegraph Key; A. H. Adams and J. N. Wallace, Sparkill, N. Y. App. filed May 31, 1912. Special construction for printing telegraph systems.

1,100,178. Spool-Head; O. F. Forsberg, New York, N. Y. App. filed Dec. 18, 1909. Carries a terminal screw.

1,100,188. Electromagnetic Device; B. Liebowitz, New York, N. Y. App. filed Sept. 5, 1912. Constructed to maintain the air-gaps substantially constant during movement of armature.

1,100,191. Electric Furnace; W. F. McNabb, Pittsburgh, Pa. App. filed Sept. 15, 1913. Crucible with arched chamber forming an arc chamber therebeneath.

1,100,207. Semaphorical Direction Indicator; G. F. Watts, Brooklyn, N. Y. App. filed April 25, 1913. Semaphore rear-end auto signal.

1,100,225. Electric Testing Apparatus; J. H. Conlon, Union, Ore. App. filed May 14, 1913. For testing fuses, lamps, wiring, etc.

1,100,243. Railway Signal Apparatus; G. Jackson, Jr., Hohokus, N. J. App. filed July 11, 1913. Signifies approach of a car to a crossing.

1,100,247. Sash or Frame Construction; L. S. Lachman, New York, N. Y. App. filed Sept. 26, 1913. Button applied to and welded to the joint formed by intersecting frame members.

1,100,253. Electric Switch; A. N. Petit, West Orange, N. J. App. filed Jan. 2, 1913. Pull socket construction.

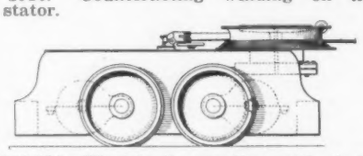
1,100,262. Means for Handling and Distributing Parcels, Bales, Loads and Other Articles; A. G. Seaman, Bowden, England. App. filed July 9, 1912. Self-propelled vehicles traveling at predetermined intervals upon a main track and from sidings onto the main track.

1,100,268. Interlocking Overhead Trolleys; S. B. Stewart, Jr., Schenectady, N. Y. App. filed July 2, 1908. For roads operating on different current at different sections; trolley in service locks the other trolley out of commission.

1,100,290. Method of and Apparatus for Electrolyzing Liquids; H. H. Dow, Midland, Mich. App. filed Dec. 30, 1912. Electrically treating natural brines in the production of chlorine and alkali.

1,100,293. Electrical Vaporizer Attachment for Gas Engines; L. L. Forde, Laurinburg, N. C. App. filed Jan. 6, 1914. Plug carrying heater coil inserted in engine intake.

1,100,294. System for Preventing Shaft Voltages or Bearing Currents in Electric Machines; W. Frick, Frankfort-on-the-Main, Germany. App. filed April 9, 1910. Counteracting winding on the stator.



1,100,139—Electric Locomotive with Automatic Cable Reel

1,100,336. Miner's and Like Electric Safety Lamp; P. Wolf, Zwickau, Germany. App. filed Jan. 30, 1913. Lamp removable without removing the glass cylinder of the lamp.

1,100,340. Potential Regulator for Dynamo-Electric Machines; V. G. Apple, Dayton, Ohio. App. filed May 31, 1911. For maintaining substantially constant the difference of potential at the dynamo terminals.

1,100,341. Indicator; V. G. Apple and G. B. Sayre, Dayton, Ohio. App. filed Oct. 6, 1913. "On" and "off" indicator for autos to show whether storage battery and dynamo are connected.

1,100,358. Combined Jack and Signal; A. F. Dixon, Newark, N. J. App. filed March 16, 1909. When plug is inserted in the jack it forces the target to its normal restored position.

1,100,382. Signaling System; M. Levison, Chicago, Ill. App. filed May 27, 1912. Call system for hospitals.

1,100,383. Thermostat; G. W. Lorimer, Piqua, Ohio. App. filed Aug. 26, 1912. For fire-alarm purposes; adjustable and has manually operable circuit-closing attachment.

1,100,385. Control System for Automatic Telephone Switches; F. R. McBerty, Antwerp, Belgium. App. filed Dec. 7, 1912. Avoids unnecessary running of the switch-driving motor.

1,100,407. Electric Control System; H. A. Steen, Milwaukee, Wis. App. filed Nov. 2, 1910. For preventing a too rapid accelerating movement of the motor controller.

1,100,408. Interbraced Pantograph Trolley; J. A. Townsend, Pasadena, Cal. App. filed June 17, 1913. Has obliquely disposed pivoted pantograph arms.

1,100,413. Selective Impulse Transmitter; J. A. Wotton, Montclair, N. J. App. filed Feb. 8, 1912. Combination of impulse transmitter and controlling mechanism with key plungers.

1,100,428. Circuit-Controlling Device; C. C. Graves, Newark, N. J. App. filed March 27, 1913. Improved electromagnetic relay construction and mounting.

1,100,480. Telephone Equipment; W. M. Haralson and J. F. Pilkington, Dallas, Tex. App. filed June 6, 1913. Has an electric light illuminating the dial of the automatic telephone.

1,100,485. Shield for Circuit Closer; J. F. Kelly, Pittsfield, Mass. App. filed May 31, 1912. Automatic closure for mercury-containing trough during the threading of the note-sheet in an automatic piano player.

1,100,501. Electromagnetically Controlled Keyboard for Perforating Apparatus; B. Soldatencow, Paris, France. App. filed Jan. 8, 1913. For perforating telegraphic tape.

1,100,505. Electric Outlet Fitting; G. B. Thomas, Bridgeport, Conn. App. filed Feb. 5, 1913. Combination fitting with switch and pilot light, as for use with electric irons, etc.

1,100,515. Electric Switch; J. M. S. Anderson, Bridgeport, Conn. App. filed Aug. 29, 1913. Rotary snap switch with lock preventing reverse rotation.

1,100,539. Cyclical Process of Fixing Atmospheric Nitrogen; K. F. Cooper, Buffalo, N. Y. App. filed Feb. 10, 1914. Employs calcium carbide.

1,100,542. Trolley Guard; R. Dac, Passaic, N. J. App. filed Dec. 24, 1913. Pivoted spring-pressed guards projected up at opposite sides of trolley wheel.

1,100,567. Dynamo-Electric Machine; W. Holt, Erdington, Birmingham, England. App. filed Nov. 3, 1911. Axle-driven train-lighting system.

1,100,584. Means for Regulating Electric-Lamp Circuits; H. Leitner, London, Eng. App. filed April 11, 1912. For preventing "over-volting" of lamps in train-lighting systems.

1,100,585. Electric Heating Coil; C. C. Lilibridge, Hutchinson, Kan. App. filed July 21, 1913. Insulating plates bound to a combustible spacing material by the current-conducting coil.

1,100,614. Wire Tapper; S. J. Pukropp, Sturgeon Lake, Minn. App. filed Aug. 30, 1913. Has a rod provided with folding contact grapples at its upper end for engagement with the live wires.

1,100,633. Alarm Lock; C. C. Tuch, Honolulu, Territory Hawaii. App. filed Oct. 3, 1913. Springs which hold the locking bolt in place also perform the function of contacts for an alarm circuit.

1,100,639. Process and Apparatus for Making Phosphoric Acid and Compounds of the Same; F. S. Washburn, Nashville, Tenn. App. filed Feb. 17, 1914. Preheats compound of phosphate rock, silicious material and carbonaceous material in furnace and discharges said mass into electric furnace.

1,100,651. Alternating-Current Magneto for Ignition and Combustion Engines; G. A. Briggs, Elkhart, Ind. App. filed Jan. 22, 1912. Includes a hammer actuated by a cam to operate the movable contact member.

1,100,680. Socket or Base of Trolley Poles for Electric-Traction Systems; E. M. Munro, London, England. App. filed Feb. 17, 1913. For trackless trolley systems.

1,100,681. Electric Lock and Alarm Apparatus; O. Nitsch, Harburg-on-the-Elbe, Germany. App. filed Jan. 29, 1914. Door-lock alarm.

13,748 (reissue). Insulator; J. Ellis, St. James, Mo. App. filed April 28, 1913 (Original patent No. 1,029,980, June 18, 1912.) Has notches which receive and lock the wire in place.

13,750 (reissue). Circuit-Controlling Device; W. B. Hughes, Newark, N. J. App. filed July 12, 1913. (Original patent No. 1,016,268, Feb. 6, 1912.) Automatic thermally controlled fire-alarm device.

13,753 (reissue). System of Control for Dynamo-Electric Machines; J. N. Mahoney, Wilkinsburg, Pa. App. filed Feb. 25, 1914. (Original patent No. 1,056,921, March 25, 1913.) Includes liquid rheostats; for controlling plurality of electric locomotives from single master controller.

Electrical World

McGraw Publishing Co., Inc.
Volume 53, Number 26
New York, June 27, 1914

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Here's the last word in meter construction

With meters, the same as all other electrical products, we have been constantly making improvements. We have not been able to increase their accuracy very much because for years our meters have been almost perfect in this respect. We have, however, gradually simplified construction and eliminated many parts previously considered necessary. Our K2, K3 and K4 meters were each a step in this direction, but in our new K5 our engineers have just about reached the limit of simplicity, yet it's actually as accurate and reliable as any meter that has ever been built. Bulletin No. 46203 explains how it is designed and constructed.

FORT WAYNE ELECTRIC WORKS

Branch Offices All Large Cities — of General Electric Company — Home Office, Fort Wayne, Ind.

WESTON

MINIATURE PRECISION INSTRUMENTS

for DIRECT CURRENT

A new group of very small Indicating Instruments.

COMPACT—ACCURATE—DURABLE—BEAUTIFUL

MODEL 280, Single Range Portable Voltmeter.
One-half Size.

Portable

Voltmeters, Millivoltmeters, Volt-Ammeters, Ammeters, Mil-Ammeters, are supplied in single, double and triple ranges.

The triple range Volt-Ammeter comprising *six* instruments in one.

The group also includes Battery Testers.

MODEL 280, Triple Range Portable Volt-ammeter.
One-half Size.

MODEL 267, Switchboard Ammeter.
One-half Size.

Switchboard

Voltmeters
Volt-Ammeters
Ammeters
Mil-Ammeters

This new line of instruments represents the latest development of the pivoted moving coil, permanent magnet type for low ranges.

The refinement of design and mechanical work in them has been carried to a degree which would appear to be almost impossible of accomplishment, if the results were not evident in the instruments themselves.

MODEL 268, Switchboard Volt-ammeter. Reads Amperes. Press Button for Volts.
One-half Size.

They embody characteristics which have made the well known Weston Standards famous throughout the world.

They are accurate, dead beat and extremely sensitive.

They may be left continuously in circuit at full load without injury and are shielded against the external electrical and magnetic influences of other apparatus in their vicinity.

They are substantially constructed and may be safely sent long distances through the mails and will withstand an extraordinary amount of vibration without injury.

They have the longest scale ever provided in instruments with equal length of pointer.

Each model has been thoroughly tested under the most severe conditions of service and in experiments extending over more than one year.

The portable instruments may be conveniently carried in the coat pocket.

The prices have been established upon so low a scale that any one may possess one or more of these remarkable instruments at moderate cost.

If you cannot obtain the Instruments desired from your dealer, write to us.

The several models and ranges offer a selection from ***over 300 different combinations, listed in Bulletin No. 8,*** which will be mailed upon request.

Weston Electrical Instrument Company

Main Office and Works: Newark, N. J.

Mr. Stanley Brown,
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New York City.

Badt-Westburg Elec. Co.,
832 Monadnock Block,
Chicago, Ill.

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Philadelphia, Pa.

Mr. Geo. H. Moseman,
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Boston, Mass.

Mr. Milton Mill,
915 Olive St.,
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Weston Electrical Instrument Co.,
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Holborn, London, E. C.

Electrical World

New York, June 27, 1914

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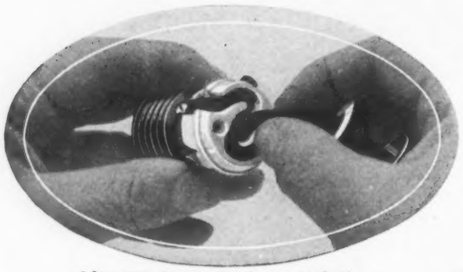
ELECTRICAL WORLD—MEMBER SOCIETY FOR ELECTRICAL DEVELOPMENT, INC.—"DO IT ELECTRICALLY"

CUTLER-HAMMER



After securing the cord terminals the conductors are simply placed in the grooves and the cap and shell locked. No knotting of cord is necessary.

The Natural Way to Operate a Lamp Socket

PUSH THE BUTTON

Easy operation of a pendent socket is only possible with push-buttons as provided in the new C-H line.

On grasping the socket the thumb and finger are placed in just the right position for operating the push-bar. One hand only is needed and there is no twisting or jerking of the lamp and socket.

All Cutler-Hammer Pendent Sockets Have Strain Relief

The upper part of the body of every C-H pendent socket has an easily-wired strain relief. After the terminals are secured the conductors of the cord are simply placed in grooves in the socket body as shown above. When the shell, cap, and cap outlet bushing are assembled a pull can be exerted sufficient to break a No. 18 two-conductor cord without imparting any strain to the cord terminal connections.

No Knotting of Cord Saves Time

There is no need for a knot in the cord nor is there any time wasted in threading the conductors as is necessary with some strain relief devices.

High Capacity—660 Watts, 250 Volts

Both the fixture and pendent type of C-H brass shell sockets have the high rating of 660 watts, 250 volts as against the usual 250 watt rating. The higher capacity is particularly suitable now because of the extensive use of electrical devices operated from lamp sockets. The quick make-and-break mechanism used is the same as is employed in other Cutler-Hammer switch devices having the still higher rating of 750 watts. The Underwriters' maximum rating for screw shell sockets is, however, 660 watts.

See these new sockets at your jobber's or write for descriptive literature today.

THE CUTLER-HAMMER MFG. CO. MILWAUKEE

NEW YORK: 50 Church Street CHICAGO: Peoples Gas Bldg. PITTSBURG: Farmers' Bank Bldg. BOSTON: Columbian Life Bldg.
PHILADELPHIA: 1201 Chestnut Street CLEVELAND: Schofield Building CINCINNATI: Fourth Nat'l Bank Bldg.
PACIFIC COAST AGENT: H. B. Squires Co., 579 Howard St., SAN FRANCISCO, San Fernando Bldg., LOS ANGELES and Morgan Building, PORTLAND, ORE.

Oil Switches, Oil Circuit Breakers, Carbon-Break Circuit Breakers, Relays and Transformers

C for correctness in design, material and workmanship.

O for the "O" in OK.

N for necessary—in all good installations

D for deliveries—prompt ones, too.

I for incomparable—as proved by their record in service.

T for trustworthy—you can rely on CONDIT apparatus.

Condit Electrical Mfg. Co.

Manufacturers of Electrical Protective Devices

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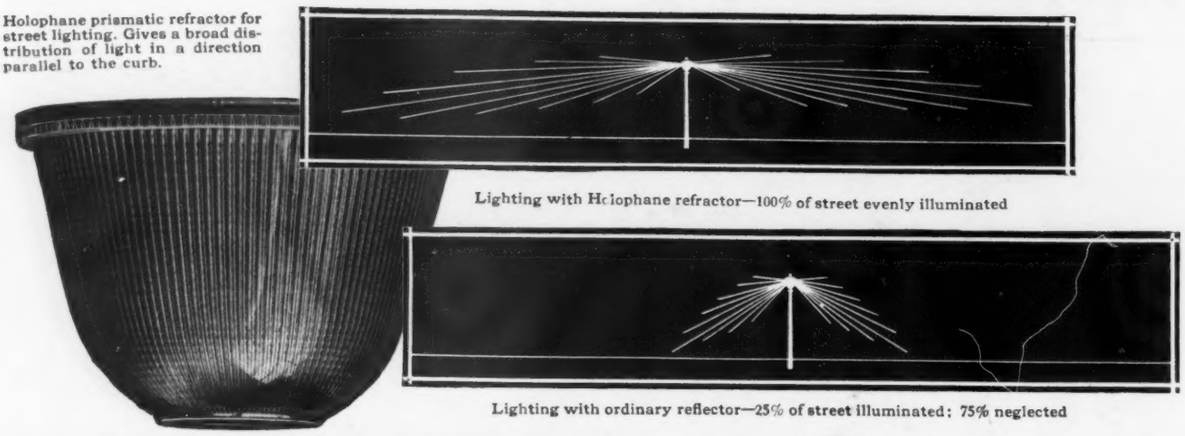
The National

Published for the information of Central Station Men, Electrical Contractors, Jobbers and Dealers

NELA PARK,



Holophane prismatic refractor for street lighting. Gives a broad distribution of light in a direction parallel to the curb.

Lighting with Holophane refractor—100% of street evenly illuminated

Lighting with ordinary reflector—25% of street illuminated; 75% neglected

FAVORS REFRACTORS AND NEW MAZDAS FOR STREET LIGHTING

National Electric Light Association Committee Approves Double Efficiency MAZDA Lamps With New Holophane Prismatic Unit for Street Illumination

It is a field rich in possibilities—one full of excellent opportunities for increasing business. Such was the opinion of the Committee reporting on the lighting of interurban highways before the N. E. L. A. three weeks ago in Philadelphia.

"We secured sufficient information," said the committee, "to convince us that the lighting of interurban highways was now receiving, and would in the future receive more attention from Central Station managers than it has up to this time."

A section of the printed report of this committee reads further: "Your committee after having given this matter some very considerable attention, personal inspection and review, begs to recommend for the consideration of the members of the National Electric Light Association, that installations of interurban highway lighting, wherever possible and expedient, include lighting units substantially in accordance with the following classifications:

A.—Low Intensity Illuminants —100 c-p. high efficiency MAZDA lamps with refractors.

B.—High Intensity Illuminants —Approximately 300 watts with diffusing globes—....—High efficiency MAZDA lamps."

The Committee describes the Holophane refractor as follows: "This type of prismatic refractor was designed with refracting prisms to spread the light out at a considerable wider angle than a lamp alone or a lamp and reflector could do, the maximum candle-

(Continued on page 2)

The salesman easily sells "Frontlites" on their advertising merits

"FRONTLITES" ARE LEAST EXPENSIVE ADVERTISEMENTS

Cost Less Than Newspaper Publicity and are More Effective

For local advertising, brilliant illumination ranks second to no other method. It claims recognition from any business man who is at all dependent upon the night crowds that frequent his neighborhood. Drug stores, moving picture houses, cafes, etc., having the most cheerful appearance get the biggest patronage.

Herein lies an opportunity for every electrical man. In the new National MAZDA "Frontlite" he has a low priced, powerful lighting unit to offer that provides this class of business with a local advertising proposition unequalled for economy and effectiveness.

The operating cost of one "Frontlite" burning four hours every night will cost say, $4.50 a month. This amount of money would buy on the average a three and a half inch single column newspaper advertisement—one insertion only. The newspaper advertisement would reach a great number of people who, living at a distance, would never have the opportunity of entering the store advertised. The merchant pays for waste circulation.

On the other hand, a "Frontlite" advertises every night and to people right on the spot. It cannot be passed by unnoticed. One or two extra sales per night as a result pays for the month's advertising.

Mazda Progress

CLEVELAND, JUNE 27 No. 9

Big factors in the sale of National MAZDA miniature lamps. They enable you to ring up miniature sales on your cash register

KEEPS MINIATURE LAMP STOCKS ALWAYS MOVING

National MAZDA Miniature Selling Helps Produce Highly Profitable Business. They Make Customers, Sales and Quick Turnovers

If you sell National MAZDA Minature lamps you are entitled to all the service features that go with them. Are you building up an ever growing business with their assistance? Our service to you is many sided. It is all the more effective because it begins with a high quality product. Whenever you get a chance to call a customer's attention to National MAZDA Miniatures don't fail to make him understand that they are the same in quality as the large National lamps he burns in his home, store, office or factory.

The National Miniature Mazdafier, newspaper copy and cuts, lantern slides, form letters, window trims, weather proof placards, new price lists, vest pocket guides, etc. are different phases of the service that is yours for the asking.

The people who read the Saturday Evening Post read our advertisements and a lot of them, perhaps the majority, are convinced of the merits of National MAZDA Miniatures—but where to get them, that is the difficulty. Your co-operation at this point is vital in transforming these readers into actual lamp customers. You are the man at the lever—you can start the whole machine simply by letting these people know that your store is the nearest place where they can buy National MAZDA Miniature lamps.

You can make the next few months record breakers for miniature lamp sales by spreading the news of the reduced prices. Look over the list in the second paragraph preceding this. Order a supply of what material you can use to best advantage from the Division of the National Lamp Works with whom you do business.

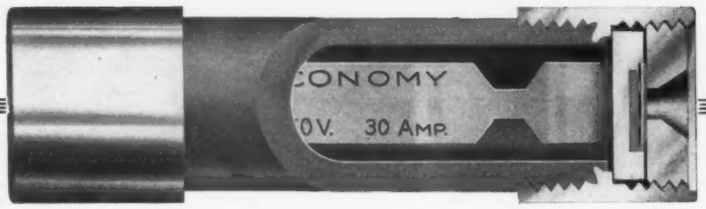
NATIONAL LAMP WORKS
OF GENERAL ELECTRIC CO.
NELA PARK, CLEVELAND
Member Society for Electrical Development
"DO IT ELECTRICALLY"

(Continued from page 1)

power of the unit being from 10 to 15 degrees below the horizontal. The refractor consists of two pieces of glass, one with horizontal directing prisms on the outside and the other with vertical diffusing prisms on the inside. These two pieces are fastened together at top and bottom, making a single unit, smooth both inside and out, the prisms being face to face. The result is a piece of prismatic glassware highly effective in re-directing and diffusing light.

National Quality Guarantees

ECONOMY FERRULE TYPE RENEWABLE FUSES



BESIDES giving to the trade a uniformly rated, renewable ferrule type fuse, possessing unvarying performance characteristics, Economy Ferrule Type Fuses have obviated the faults existing in the old style non-renewable fuses as well as those found in refillable fuses of other makes.

For instance:—The ferrules are securely and permanently fastened to the end of the fibre shell by the manufacturers, therefore the brass surface is never scarred by the grip of wrench or pliers, and thus the ferrules always present a smooth, full, round surface for good contact. Venting is permanently provided for by thread clearance between metal and metal.

The ends of the assembled fuse are closed by slotted and threaded end-plugs, which engage the terminals of the fuse element and provide a tight metal to metal contact between fuse link and ferrules.

The most important of the many improvements presented in the new fuses is found in the perfection of the ECONOMY "DROP-OUT" RENEWABLE LINK. The fusible element between the restricted portions drops out of the circuit in *metallic form* when the fuse operates—even on heavy overload.

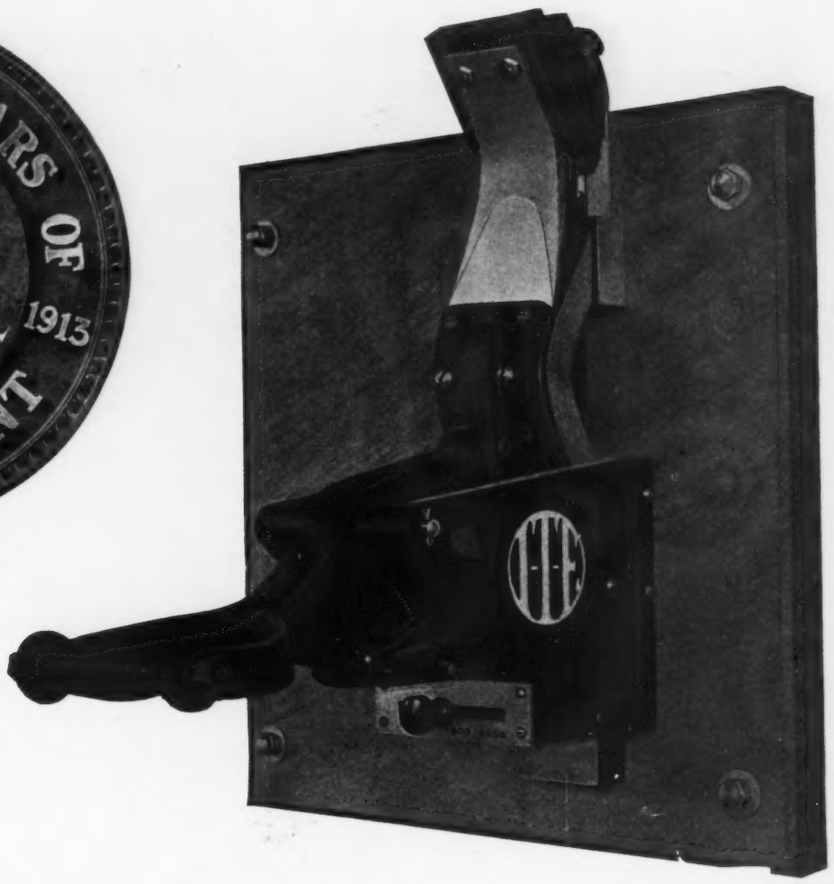
This is also true of the knife blade type of ECONOMY renewable cartridge FUSES, in which the use of the Economy "DROP-OUT" Renewal Link has entirely done away with the employment of filling material of any kind.

Your yearly fuse maintenance costs may be reduced three-quarters to four-fifths by the use of ECONOMY renewable cartridge FUSES. This statement is based on what is actually being accomplished by Economy Fuse users today. Bulletin No. 27A gives full information. Write for it at once.

Economy Fuse & Mfg. Co.

Kinzie and Orleans Streets, Chicago

I-T-E CIRCUIT BREAKER



DESIGNED especially with a view to the exacting requirements of railway and other heavy service, the "L-L" type Circuit Breaker has become the accepted standard for practically every class of installation where utmost reliability under severest conditions is of prime importance. Extreme simplicity of construction and careful proportioning of all parts minimize the possibility of breakdown and practically eliminate the item of "maintenance cost." The mechanical and electrical excellences of the "L-L" type Circuit Breaker, combined with its symmetrical design and faultless finish, have established it as a standard for high-grade switchboard work.

To create and maintain a reputation; to build a piece of apparatus which the whole round world admits to be the best of its class; to create a world standard and keep it at a level unapproached by others; such is the record of this Company, which this year rounds out its first quarter century.

THE CUTTER COMPANY

PHILADELPHIA

THE CUTTER CO., 50 Church Street, New York City.
THE CUTTER CO., Monadnock Block, Chicago, Ill.
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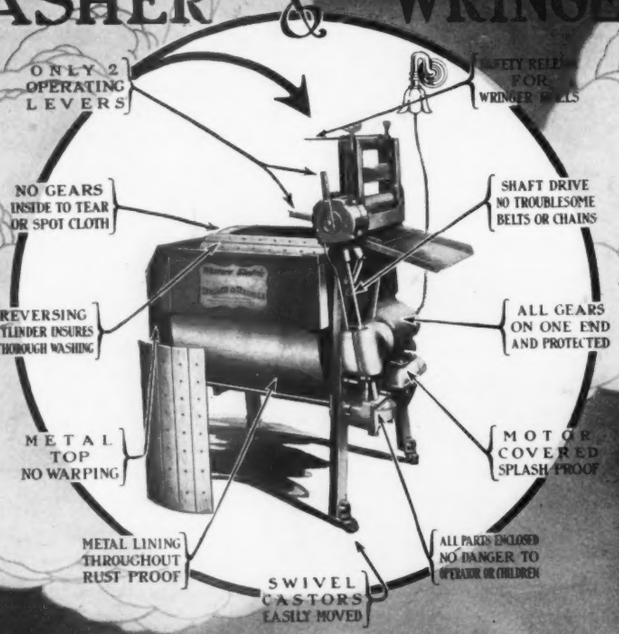
THE CUTTER CO., Traders Bank Bldg., Toronto.
THE CUTTER CO., Ford Bldg., Detroit, Mich.
THE CUTTER CO., Metropolitan Life Bldg., Minneapolis, Minn.
THE CUTTER CO., Telephone Bldg., Indianapolis, Ind.
ELECTRIC MFS. SALES CO., Denver, Colo.
ELECTRIC MFS. SALES CO., Salt Lake City, Utah.
ECCLES & SMITH CO., Los Angeles, Cal.
ECCLES & SMITH CO., San Francisco, Cal.
ECCLES & SMITH CO., Portland, Ore.
FRANK DARLING & CO., Vancouver, B. C.

Western Electric

CONLON

WASHER & WRINGER


ONLY 2 OPERATING LEVERS
SAFETY RELEASE FOR WRINGER ROLLS
NO GEARS INSIDE TO TEAR OR SPOT CLOTH
SHAFT DRIVE NO TROUBLESOME BELTS OR CHAINS
REVERSING CYLINDER INSURES THOROUGH WASHING
ALL GEARS ON ONE END AND PROTECTED
METAL TOP NO WARPING
MOTOR COVERED SPLASH PROOF
METAL LINING THROUGHOUT RUST PROOF
ALL PARTS ENCLOSED NO DANGER TO OPERATOR OR CHILDREN
SWIVEL CASTORS EASILY MOVED

Manufactured by the
Conlon Electric Washer Company
Distributed by

"SAVE TIME AND FREIGHT"

DYNAMOS-MOTORS
WESTERN ELECTRIC COMPANY
CABLE-TELEPHONES-SUPPLIES

"TELEPHONE OUR NEAREST HOUSE"

Western Electric Company

Manufacturers of the 8,000,000 "Bell" Telephones

New York	Atlanta	Chicago	Kansas City	San Francisco	Montreal	London
Buffalo	Richmond	Milwaukee	Omaha	Oakland	Toronto	Paris
Philadelphia	Savannah	Indianapolis	Oklahoma City	Los Angeles	Winnipeg	Berlin
Boston	New Orleans	Detroit	Denver	Salt Lake City	Calgary	Antwerp
Pittsburgh	Houston	Cincinnati	Minneapolis	Seattle	Vancouver	Milan
Cleveland	Dallas	St. Louis	St. Paul	Portland	Edmonton	Rome

Johannesburg Sidney St. Petersburg Vienna Buenos Ayres Tokyo

EQUIPMENT FOR EVERY ELECTRICAL NEED

"MEMBER OF"

SERVICE — THE SOCIETY FOR ELECTRICAL DEVELOPMENT INC NEW YORK — SAFETY

"DO-IT ELECTRICALLY"

THE BEST WASHE
AND HOW TO SELL IT
With the "
Western Electric
Washer and Wringer
BLUE MONDAY
DON'T WASH ALL DAY
Western Electric
Washer & Wringer
SENT ON 15 DAYS TRIAL
Mr. Central Station Manager
Did you get your copy of this folder?
If not, write for it and see the complete line of sales helps that is at your disposal—
Including lantern slides, electrotypes for newspaper ads, and street car cards.

"SAVE TIME AND FREIGHT"
DYNAMOS-MOTORS
WESTERN ELECTRIC COMPANY
CABLE-TELEPHONES-SUPPLIES
"TELEPHONE OUR NEAREST HOUSE"

Western Electric Company

Manufacturers of the 8,000,000 "Bell" Telephones

New York	Atlanta	Chicago	Kansas City	San Francisco	Montreal	London
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Pittsburgh	Houston	Cincinnati	Minneapolis	Seattle	Vancouver	Milan
Cleveland	Dallas	St. Louis	St. Paul	Portland	Edmonton	Rome

Johannesburg Sidney St. Petersburg Vienna Buenos Ayres Tokyo

EQUIPMENT FOR EVERY ELECTRICAL NEED

"MEMBER OF"
SERVICE
THE SOCIETY FOR ELECTRICAL DEVELOPMENT INC NEW YORK
ECONOMY
SAFETY
"DO-IT ELECTRICALLY"

Sell the Accident-Proof Improved

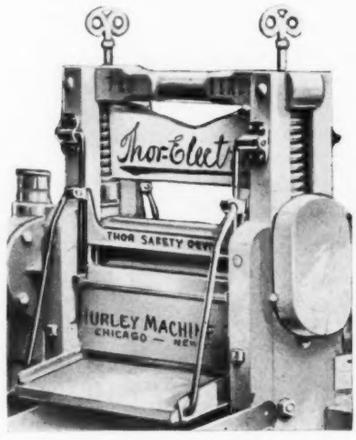
Thor

Electric Washer No. 25

Simplicity is the secret of THOR superiority—in operation and construction. It is shaft driven, by smooth running, spiral bevel gears, which are enclosed. This mechanism is absolutely noiseless while in action. Two levers instantly control operation—one for the washer and one for the wringer. A push-button switch—at the side of wringer—instantly shuts off the current.

Simple, Durable Construction All Moving Parts Enclosed

The Improved THOR is constructed of superior materials throughout, and although it is guaranteed for FIVE YEARS, it is built to last a lifetime. Machine is handsomely finished in white enamel.



The Accident-Proof Wringer

The wringer is fitted with a patented safety attachment, which absolutely prevents accidents. This is not a *releasing device*, which acts *after* an accident has occurred, but a device which *prevents* operator from getting fingers or hand caught while the rolls are in motion. It is made of brass and is rust-proof.

The THOR goes through a 25-inch doorway without dismantling wringer or any other part.

HURLEY SERVICE

Our interest in your success does not end with the sale of a machine to you. We help you sell the Improved Thor. This is a part of our dealers' service and you must be a Hurley customer to realize the meaning of this service, to its fullest extent.

National Advertising

The Improved Thor is being advertised nationally right now in the Saturday Evening Post. All inquiries received are referred to our dealers. Take advantage of this 2,000,000 circulation—have an Improved Thor on your salesfloor.

Identify Your Business with Satisfied Trade. **Write Us Today for Agents Discount and Selling Plan.**

Hurley Machine Co., Executive Offices: 23 So. Clinton St., Chicago

Branches: 945 Broadway, New York. 525 Mission St., San Francisco, Cal. Pearl St. and Atlantic Ave., Boston, Mass. 111-113 E. Third St., Los Angeles, Cal. 231 15th St., Denver, Colo. Atlantic & Liberty Sts., Toronto, Canada.

Presturn Sockets

No. 3000

No. 3010

HUBBELL SOCKETS CONCERN YOUR POCKETS

The high Hubbell standard of quality put into every Presturn Socket insures quick and satisfactory sales. Every need for socket adaptability, service and design can be supplied and best supplied by the Presturn Line. You can fill every need you are asked to fill and tuck away a tidy profit. There are no wrongs to be adjusted in a Hubbell installation—no excuses to be made to customers.

PRESTURN SECURITY NINETEEN TIMES SECURE

By actual test Presturn Socket Shells have stood pulling strains from 350 to 700 pounds. The nineteen holding points of cap and base form a grip that guards the inner mechanism throughout the life of the socket. A press and turn of the shell releases the cap as quickly as it locks.

The big Hubbell Catalog is a 175 page Guide to electrical specialties. If you haven't a copy it is your loss. Write today.

Harvey Hubbell Inc.

Bridgeport, : : : Conn.

R. E. T. Pringle, Montreal

No. 3117

No. 3121

No. 3125

Do Your Drilling, Chipping, Caulking or Surfacing

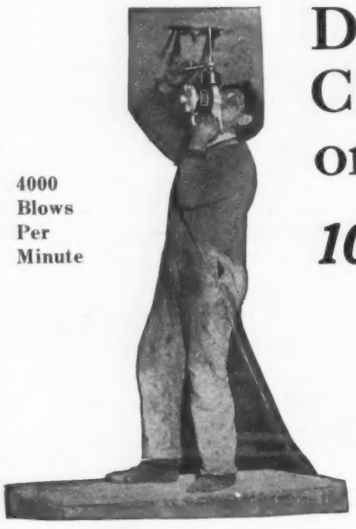
10 Times as Fast

By using either an

Electric Hammer

or the manually operated

Drilhammer



4000 Blows Per Minute

If you have a lot of work to do, the solution of the problem for you is our ELECTRIC HAMMER.

If you have but a small amount of work to do at any one time, the DRILHAMMER is the thing to use.

Our ELECTRIC HAMMER is ten times as rapid as the crude, old-fashioned, hit-and-miss method of striking the head of a drill or chisel with an ordinary hammer.

It does not cost a fifth as much for power to operate it as the pneumatic or steam-driven type. It doesn't involve any complicated generating equipment and transmission lines, such as piping, hose, etc.

It can be installed in half a minute and taken down in less time.

It is portable, self-contained and always ready for the job. Simply attach plug to any convenient electric light socket.

This ELECTRIC HAMMER is practically automatic—same pressure which holds tool against work closes switch in handle and starts operation. Delivers four thousand blows a minute. Built for various voltages. Requires only one to two amperes on 110-volt direct current. Can be used on alternating current by using a motor generator set. Bulletin "E. H." describes it.

Ceiling Work Made Easy

The Drilhammer

Does the work in one minute that takes ten times as long by cruder methods. Strikes 1000 powerful hammer blows per minute. Operator simply turns the crank. Centrifugal force does the work. Hardened tool steel hammer elements revolving at high speed strike the blows. Exceedingly simple in construction. Has no springs to weaken or wear out. Will tremendously cut down the cost of drilling concrete, brick, stone, tile, conduit, walls, floors, ceilings, etc.

Made in two sizes and accommodates drills from ¼" to 1¼". Can be carried in regular tool kit. Sold at a price which will enable every electrical worker and mechanic to have one in his kit. Write for Bulletin "W" and prices.

No Exertion

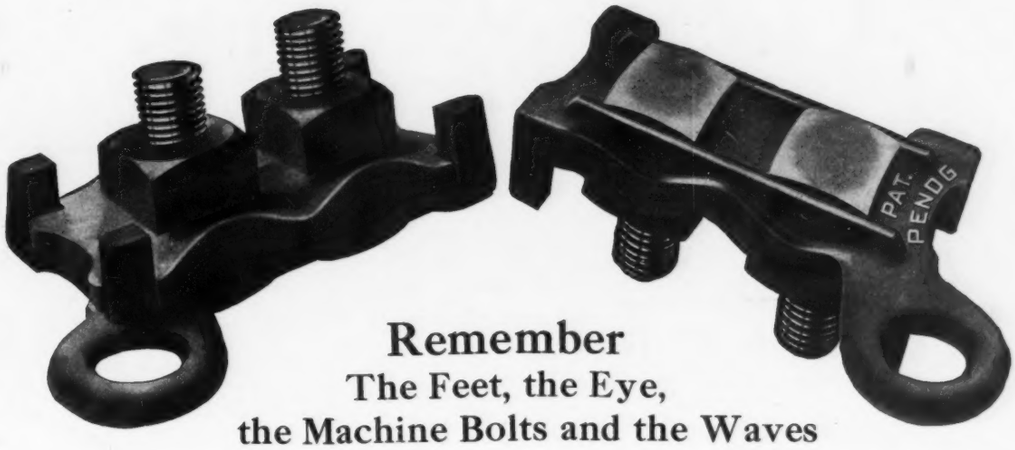
ORR & LOCKETT HARDWARE Co

Established 1872

Main Office, 14-16 W. Randolph St., Chicago

Branch Offices: 401 Broome St., New York; Room 608-79 Milk St., Boston

Do You Know That Matthews' 2-Bolt Guy Clamp Will Hold 16,000 Pounds Strain? One Clamp?



Remember
The Feet, the Eye, the Machine Bolts and the Waves

Yes, sir! 16,000 pounds. That is why we know that it is worth more than three 3-bolt clamps, as far as holding power is concerned.

Do we expect you to believe that? No! Certainly not! Don't ask you to believe anything but your own eyes. Your own tests.

Don't even ask you to pay out a cent until you are convinced that Matthews 2-Bolt Guy Clamp will not only hold more than any three 3-bolt clamps, but that it will also cost you less installed than one 3-bolt clamp.

Why does it do all of these things? Well, first of all, there's

The Feet

They permit you to put on the clamp loosely. You don't have to tighten the nuts to keep the strand from jumping out as it is pulled to its final position. They hold it in place.

The Eye

is used to pull the loose clamp to its final position. A chain lever is hooked into it and the clamp is pulled to position—not driven with a hammer. This does away with the danger of knicking the expensive guy strand by misdirected blows. The galvanizing is not injured by driving a tight clamp along the strand.

The Machine Bolts

are 5/8 inch. They have extra heavy nuts. They have great compression strength. They clamp. They force 16,000-pound Siemens Martin Strand down into

The Waves

The waves, of course, prevent any strand that is forced down into them from slipping. Fits all sizes up to ½ inch.

Free Trial Proposition

You can order any number of Matthews 2-Bolt Clamps on 30 days' trial. If they prove entirely satisfactory, pay for them. If not, return them. If your first trial order calls for 100 or more the freight will be prepaid. How many, please?

W. N. MATTHEWS & BROTHER, Inc.

Manufacturers of Matthews' Patented Money Saving Specialties

3739 Forest Park Boulevard, ST LOUIS

Hudson Terminal Bldg., 30 Church St., New York
629 Howard St. San Francisco
507 S. Clinton St., Chicago

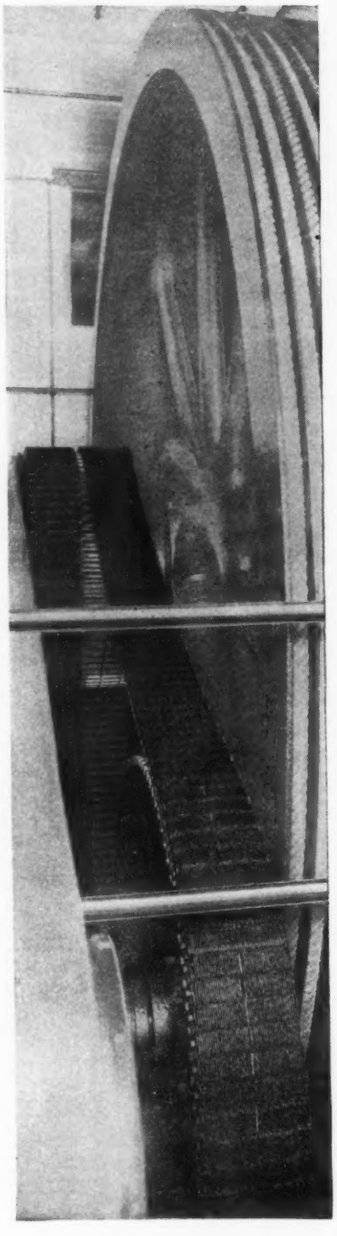
Canadian Distributors of Matthews Money Saving Specialties: The Northern Electric Company, Limited, Montreal, Halifax, Toronto, Winnipeg, Regina, Calgary, Edmonton, Vancouver, Victoria.

"A whale of a drive"

The illustration opposite shows two 175 horsepower

Morse Silent Chain Drives

installed March 1906 in the plant of a New York City Rubber Company.



Each chain is of 2-inch pitch and 10 inches wide, run on sprockets of 79 and 95 teeth set at 102½ inch centers. Each is what we would call "A whale of a drive," but——

compare these 175 horsepower chains to belt or rope drives of the same capacity and they appear small, in fact, do occupy much less floor space and head room, besides giving you almost 99% efficiency transmission of power without the noise of gearing or slipping of belting.

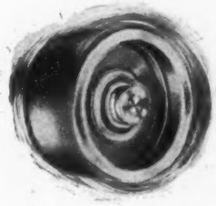
Over 1,000,000 horsepower of Morse Silent Chain Drives in daily service shows their popularity.

Write us regarding your power transmission problems. It won't cost you anything to find out how much we can save you. Ask also for Publication No. 12 containing interesting data on "the life of a chain drive."

Morse Chain Company, Ithaca, N. Y.

B-25R

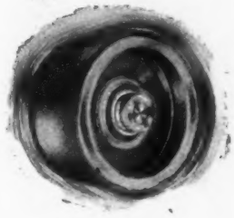
Some Pulley Builders Make Speed Their Talking Point



4 Miles a Minute!

Can you beat that?

That was the speed of rim required to burst a Rockwood Paper Pulley of 48″ diameter and 12″ face width as determined by tests made at Cornell University in 1905—to be exact the speed was 21,540 F. P. M.



3½ Miles a Minute

That's going some, too.

That was the average rim speed required to burst two Rockwood Paper Pulleys of 24″ diameters and 6″ face widths as determined by tests made at Purdue University in 1909—the exact speeds were 18,420 and 17,700 F. P. M. These are the only tests on record, but

You'd have to go a long ways to find another pulley to rank in the same speed class with

The Rockwood Paper Pulley

It's the only pulley correct in theoretical design and actual construction.

"A series of perfectly true, solid, circular rings cemented, pinned and bolted together."

If you're interested in High Speed Drives, write

The Rockwood Manufacturing Company
Indianapolis, Indiana, U. S. A.

"Safety" Steel Taped Cable

WITH an underground duct or conduit system of distribution, frost line determines the minimum depth of excavation. With a SAFETY Steel Taped Cable system, a spade's depth in earth is all the cover needed—and in a paved street, the paving itself is sufficient cover. For SAFETY Cable is heat-proof, cold-proof, water-proof, almost injury proof. Its double spiral layer of tough steel tape prevents any but wilful penetration. And this steel cover protects and maintains the water-proof lead sheathing and the flexible insulating layers within. There have been cases where a SAFETY Cable line has been laid on a lake bed—and carries its current without trouble. The municipality planning to light its streets, boulevards or parks—and seeking the best results at least cost—cannot neglect to investigate SAFETY Steel Taped Cable.

Crossing a Street with a "Safety" Cable Line. Could anything be Easier? Just One Row of Brick Lifted.

SAFETY INSULATED WIRE & CABLE CO.

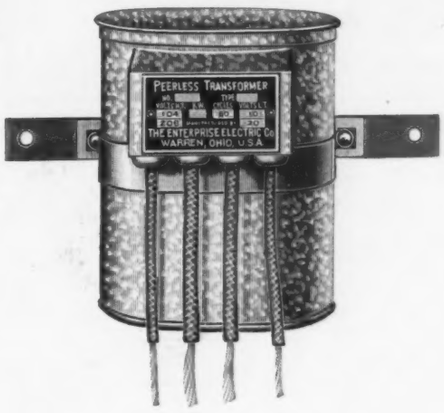
114 Liberty Street, NEW YORK

CHICAGO BOSTON
ATLANTA SAN FRANCISCO

No. SIW-75

Lower Estimates Mean More Sign Business

A material assistance to your new business department, especially in the sign lighting field, is a transformer that justifies a low estimate of current consumption. The one thing that interests the prospective sign advertiser is how much it's going to cost him to run it.



PEERLESS SIGN LAMP TRANSFORMERS

afford the greatest economy to the customer because they are highly efficient and deliver *exact rated voltage at full load.* They insure a uniform light and entire freedom from the hammer-blows of fluctuating voltage, so destructive to lamp filaments. This means long lamp life and economy to the consumer.

Peerless Sign Lamp Transformers are correctly designed. Cases are filled with solid insulating compound which renders the transformers absolutely moisture proof. Construction is extremely rugged and they may be installed in any position, in and out of doors.

Write for catalog and prices.

The Enterprise Electric Co., Warren, Ohio

"Transformers of all kinds for all purposes"

8532

General Devices & Fittings Co.

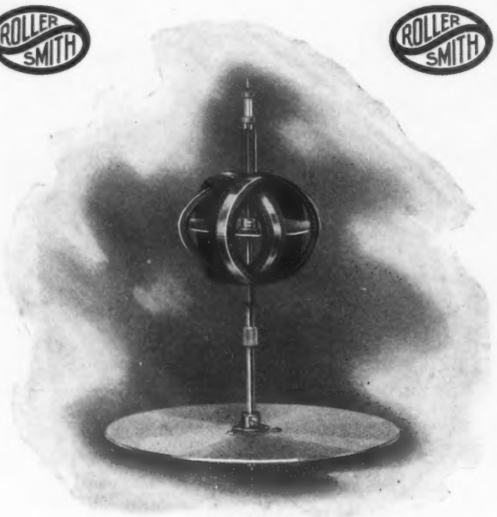
DESIGNERS, ENGINEERS AND MANUFACTURERS OF

Bus Supports, Disconnecting Switches, Clamp Insulators, Pipe Fittings for Switchboard Service, Pins, etc.

GOOD DESIGNS FIRST
TRADE MARK REG. U.S. PAT. OFF.

HIGH TENSION DEVICES FOR ANY VOLTAGE.
OUR PORCELAIN IS SUPERIOR TO ANY MADE.

817-25 W. WASHINGTON BLVD., CHICAGO, ILL.



Doesn't This Armature Look as if It Were Built for Business?

It does and it is. It is one of the elements that contribute to the high efficiency and accuracy of the Columbia type "D" watt-hour meter. Note some of the distinctive features:

COMMUTATOR. Chemically pure silver; diameter only 1/10 inch; three segments. The small size, together with the round silver tipped brushes, reduces friction to a minimum.

COILS. The three armature coils are wound in circular form, which eliminates sharp turns and consequent breakage of wires.

WORM. Accurately cut and works perfectly with the pinion.

DISK. Aluminum, stippled on both sides to insure rigidity. Note the three iron discs which together with an adjustable iron micrometer screw not shown, serve to prevent creeping, and to smooth out the irregularities of torque.

SHAFT. Bronze, light but strong.

PIVOT. Highly polished and accurately shaped steel. Removable of course.

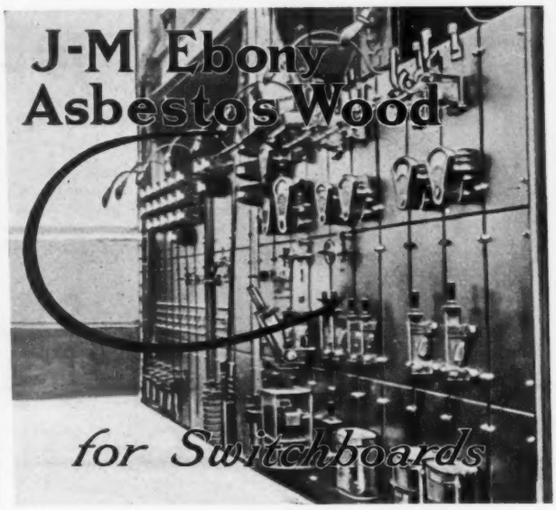
ASSEMBLY. Note especially that the complete armature is light in weight, but rigid and compact. The ratio of torque to weight is high and the potential watt loss is small. The balance of the meter is as efficiently designed and carefully constructed as the armature.

CONCLUSION. It's a mighty fine meter. Get one and prove it. Bulletin No. 97 is the one to send for.

Roller-Smith Company

203 Broadway, New York

Monadnock Block CHICAGO — **Williamson Building CLEVELAND**



Power Plant of Pacific Gas & Electric Co., San Francisco, Cal. Equipped with J-M Transite Ebony Asbestos Wood Switchboards.

better than slate or marble, because—

it is non-combustible, exceptionally strong mechanically and electrically, easily worked, non-hydroscopic and cheaper.

(Data below from tests of Underwriters Laboratories. Remember J-M Ebony Asbestos Wood is *approved* for switchboard panels and many other uses.)

Breakdown ½" thick.....25,000 volts

Resistance 9/16" thick between electrodes of 9.6 sq. in., dry, showed 45,000 megohms.

Moisture Practically unaffected by immersion in water for 216 hours. (You recall how porous marble is.)

Combustibility No effect from flame except slight calcining.

Strength Tensile strength per square inch, 3,500 lbs. Breaking strength 1-inch square section on 12" centers 325 lbs. *Twice as strong as marble, slate or soapstone.*

Crushing strength per square inch, 12,500 lbs. Transverse strength per square inch, 3,000 lbs.

Convenience As easily threaded as hard rubber. Sawed and planed like wood. Takes and keeps a beautiful finish.

If you have not considered J-M Ebony Asbestos Wood it is assuredly time to investigate *now*.

Write today to our nearest branch for sample and booklet.

H. W. JOHNS-MANVILLE CO.

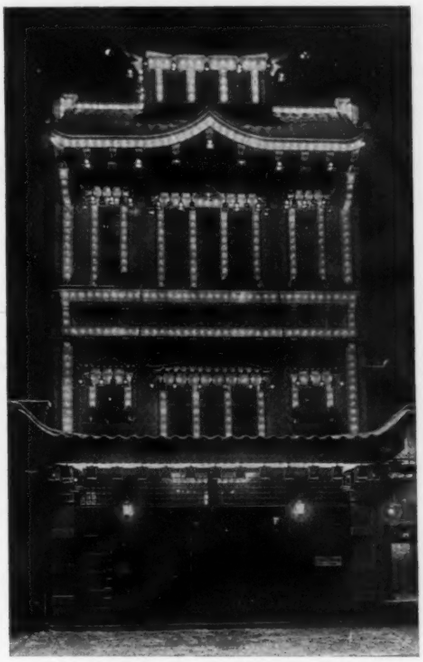
Manufacturers of Service, Subway and Transformer Boxes; Fuses; Line Material; Insulating Materials; Fibre Conduit; Friction Tapes; Dry Batteries; Lighting Systems, etc.

Akron	Cleveland		Memphis	St. Louis
Albany	Columbus		Milwaukee	St. Paul
Atlanta	Dallas		Minneapolis	Salt Lake City
Baltimore	Dayton		Newark, N. J.	San Francisco
Birmingham	Denver		New Orleans	Seattle
Boston	Detroit		New York	Syracuse
Buffalo	Duluth		Omaha	Toledo
Charlotte	Galveston	Indianapolis	Philadelphia	Washington
Chicago	Houghton	Kansas City	Pittsburgh	Wilkes-Barre
Cincinnati	Houston	Los Angeles	Portland, Ore.	Youngstown
		Louisville	Rochester	

THE CANADIAN H. W. JOHNS-MANVILLE CO., LIMITED.
Toronto Montreal Winnipeg Vancouver

For Great Britain and Continent of Europe:
TURNERS & MANVILLE, LTD., Hopetoun House, 5, Lloyds Ave., London, E. C.

Member of the Society for Electrical Development, Inc.
"DO IT ELECTRICALLY" 2435



Wired with SIMPLEX

The assurance of electrical security (freedom from so-called electrical fires, etc.) is represented in this slogan—*"Wired with Simplex."* **SIMCORE WIRES AND CABLES** (Nat. Elec. Code Standard) were installed in the picturesque **GEISHA THEATER,** Springfield, Mass., by The Tuohey Co. Every length of Simcore has

A Guarantee of Security

in the voltage tests to which each is subjected, from 33 1/3 to 100 percent greater than those required by the Underwriters.

Think what this means, not only in theaters but wherever insulated wire is used!

The Simplex Manual (1914 Edition) free on request to Dept. E.

SIMPLEX WIRE & CABLE Co

MANUFACTURERS

201 DEVONSHIRE ST. BOSTON

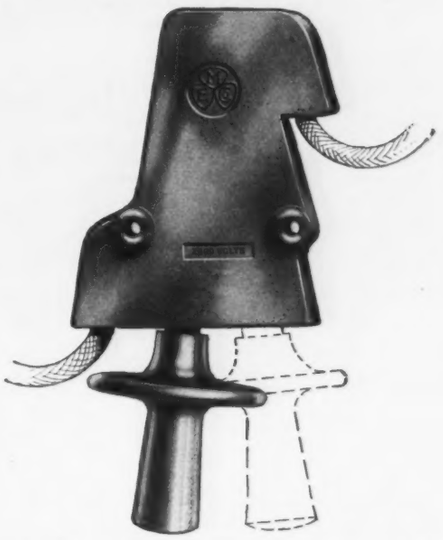
CHICAGO SAN FRANCISCO

(48-154)

ARE YOU HAVING TROUBLE

with

Primary Cutouts and Fuses?



THE METROPOLITAN Primary Pole Cutout Switch Type

Cat. No. 10350

Offers positive protection to your branch circuits, transformers and arc lamp circuits. They are designed, in case of trouble, to instantaneously open the circuit, especially where the disruptive effect is severe, due to high capacity.

A generous factor of safety is employed in the use of contact surfaces and insulation to insure satisfactory operation under the most severe conditions of service.

Constructed of heavy porcelain, in brown finish, they are so designed as to be weatherproof when installed on crossarms. Each conductor is held in position in the terminals by two screws to prevent loose connections. All live parts are amply recessed and protected to prevent injury from contact.

Let us send you full particulars.

Metropolitan Engineering Co.

42nd St. Bldg., New York

Canadian Representative — Metropolitan Engineering Co., Ltd., 90 Sherbourne St., Toronto, Canada.

Guaranteed Accuracy and Low Cost

are combined in our new Unit Type Wheatstone Bridge and Resistance Boxes. Being dial type instruments they are easier to manipulate and to keep clean than the plug type and are free from the inconvenience arising from lost plugs. Our construction makes the dial contacts of these instruments absolutely reliable. A new method of manufacturing lowers cost to us—and to you—without sacrifice of material, workmanship, or adjustment. In the Wheatstone Bridge one dial controls both bridge arms—a feature that adds greatly to the convenience of this type. Our

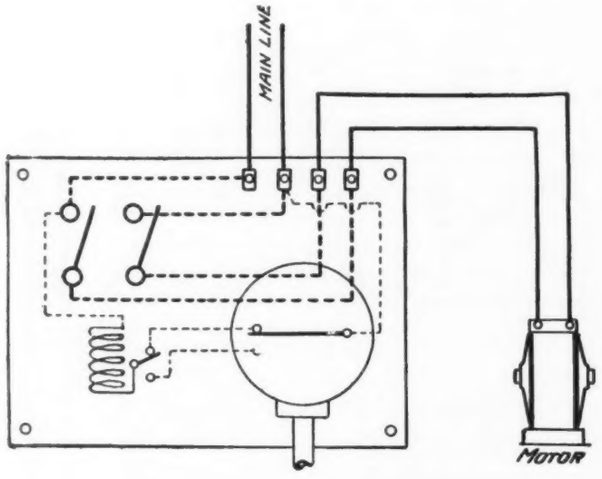
Unit Type Wheatstone Bridge and Resistance Boxes

are guaranteed as to accuracy within any reasonable degree of temperature change. The ratio coils are guaranteed accurate to within 1/20% and the rheostat coils to within 1/10%. In the resistance boxes all coils are guaranteed accurate to within 1/10%. All resistance values are adjusted in our laboratory to twice their guaranteed accuracy.

For accuracy, reliability, compactness, neat appearance, and low cost, our Unit Type meets the requirements of all. Write for Bulletin No. 476.

The Leeds & Northrup Co.
Electrical Measuring Instruments
4901 Stenton Ave., Philadelphia, Pa.

This Diagram Shows How Simple It Is



to wire up a Sundh Pressure Regulator for starting a small motor without the use of a starting resistance.

The double pole type of Pressure Regulator is shown, but in many cases of Direct Current and single-phase Alternating Current, a single pole type can be used. It may be also adapted for starting A. C. Motors of two or three phases, three wire, or two phases, four wire when it is permissible to open two circuits and to run the neutrals direct to the motor.

The Sundh Catalog contains detailed information. Shall we send it?

SUNDH ELECTRIC COMPANY
NEW YORK, U.S.A.

2

The Operator Don't Have to Stand Idle While the Motor Accelerates

if it is equipped with

The Monitor System

of machine control

"Just Press a Button"

and the progressive steps of resistance are automatically cut out so as not to strain either machine or motor.

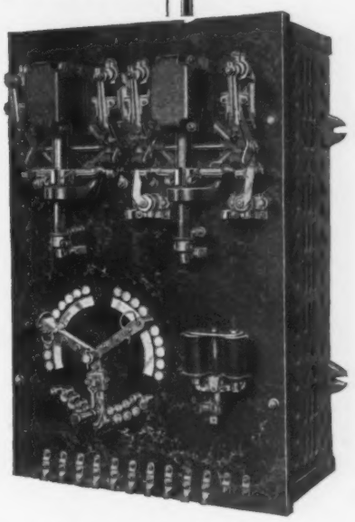
The Monitor System of machine control increases the efficiency of the machine, the motor and the operator. The controller is simple in construction and permits **of delicate adjustments in operation.**

Adaptable to all forms of service, from the smallest lathe to the largest printing press. Installation is simple and economical.

Write for bulletins describing d. c. and a. c. motor controllers.

Monitor Controller Company
111 South Gay Street, Baltimore

NEW YORK, 30 Church St.
PHILADELPHIA, 1533 Chestnut St.
CHICAGO, 1040 Old Colony Bldg.
BOSTON, 77 Franklin St.



Monitor Alternating Current Controller

Your Reputation as a Contractor

depends entirely upon the satisfactory service of your installations. Why jeopardize it by using any but the best material.

"Diamond H"
Switches and Receptacles

embody features of safety found in no others.

Only in the H switch is the mechanism protected by a substantial porcelain base covering the front of the switch.

All working parts are made of the finest case hardened tempered steel, blued to prevent rust. Contacts are of phosphor bronze and of ample size to carry any reasonable overload. H products are strongest, safest and surest.

Most economical to install and our guarantee eliminates the replacing expense invariably accompanying the use of inferior material.

Our catalog shows more than 70 H styles. Send for it today.

THE HART MFG. COMPANY, Hartford, Conn.

New York Boston Chicago Pittsburg San Francisco Denver Toronto London, Eng.

"Realflex" Armored Conductors

"Realflex" armored conductor is made of special galvanized steel wire of our own manufacture, in such a way as to form a perfect ground joint between convolutions.

It will not break; is nail, rust and rat proof.

The armor hugs the wires firmly without injury to the core.

When severed it leaves clean, even ends.

The conductor is of the highest quality of rubber insulated wire (new code).

Cores of different color save time in testing.

DISTRICT AGENTS

Pittsburgh, The Western Conduit Co., 1625 Oliver Building. Denver, The Western Conduit Co., 401 Sugar Building. Dallas, The Western Conduit Co., 915 Busch Building. San Francisco, The Western Conduit Co., 604 Mission Street. St. Louis, The Western Conduit Co., 902 Third Nat. Bank Building. Seattle, The Western Conduit Co., 535 Central Building. Atlanta, Ga., The Western Conduit Co.

The
Western Conduit Co.
Youngstown, Ohio.
Subsidiary to
The Youngstown Sheet & Tube Co.

DISTRICT AGENTS

New York, The W. A. Bonnell Co., 132 Church Street. San Francisco, Electric Agencies Co., 247 Minna Street. Boston, The Western Conduit Co., 120 Franklin Street. Detroit, Mich., J. W. McNair Elec. Co., 29 Woodward Ave. Chicago, The Western Conduit Co., 1563 McCormick Building. Boston, Mass., E. R. Bryant, 110 Pearl St.

Carrying 30 feet 3" Socket Joint.

Orangeburg Fibre Conduit

("Admitted to be the best Fibre Conduit.")

Made with four styles of joints: Socket, sleeve, screw and "Harrington," with bends and fittings for same.

Is the Lightest Conduit Made
(3" socket joint 1.2 lbs per foot.)

hence the freight and cartage charges are reduced to the minimum.

Send for The Conduit Book.

The Fibre Conduit Company

New York, 103 Park Ave.
Chicago, 1741 Monadnock Bldg.
Boston, S. B. Condit, Jr., Co.
Winnipeg, Can.
Tri-Provincial Supply Co.

Main Office and Factory
Orangeburg, N. Y.

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San Francisco, Cal.
Seattle, Wash.
Portland, Ore.
Los Angeles, Cal.
Salt Lake City, Utah.

Birmingham, Ala., McClary-Jemison Machinery Co. Bryant Zinc Co., Chicago, Ill.

For Display Case

be sure to use

"National" Metal Molding

The ideal material to use when you wire a display case is "National" Metal Molding.

How one contractor made an excellent looking job—and avoided all mutilation common to the use of other materials—is illustrated above.

"National" Metal Molding was carried up on the wood corner mold from a floor box connection underneath the case. The inside face of the corner mold had been made at an angle of 45 degrees, so when a No. 338 Internal Elbow was installed to turn out onto the ceiling a No. 437, 45-degree Flat Elbow was used to connect with the No. 335 Tee. Fitting Coupling No. 436 was used to make these connections between the two elbows and the Tee.

The case was semi-panelled from the No. 335 Tee, as shown, and four 100-watt Tungstens installed with No. 356 Receptacles.

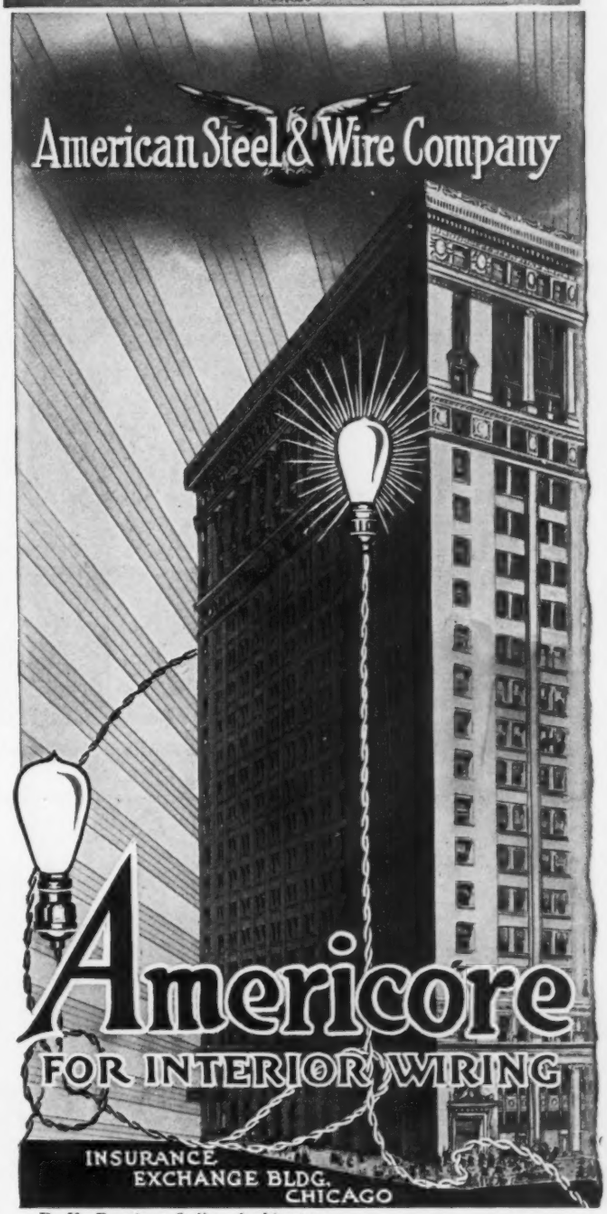
A 96-page illustrated handbook covering the installation and assembly of "National" Metal Molding and fittings sent free upon request.

National Metal Molding Company

1105 Fulton Building Pittsburg, Pa.

Boston	New York	Chicago
Denver	San Francisco	Atlanta
Portland	Los Angeles	Seattle

American Steel & Wire Company



D. H. Burnham & Co., Architects.

OVER 200,000 feet of our Americore rubber covered wire used in this building.

Every foot is carefully inspected by us in the various stages of manufacture, and when completed is finally examined and labeled under the direction of the Underwriters' Laboratories.

We are prepared to furnish this wire in all sizes and conductors, both solid and flexible, from warehouses conveniently located for quick delivery to all parts of the country.

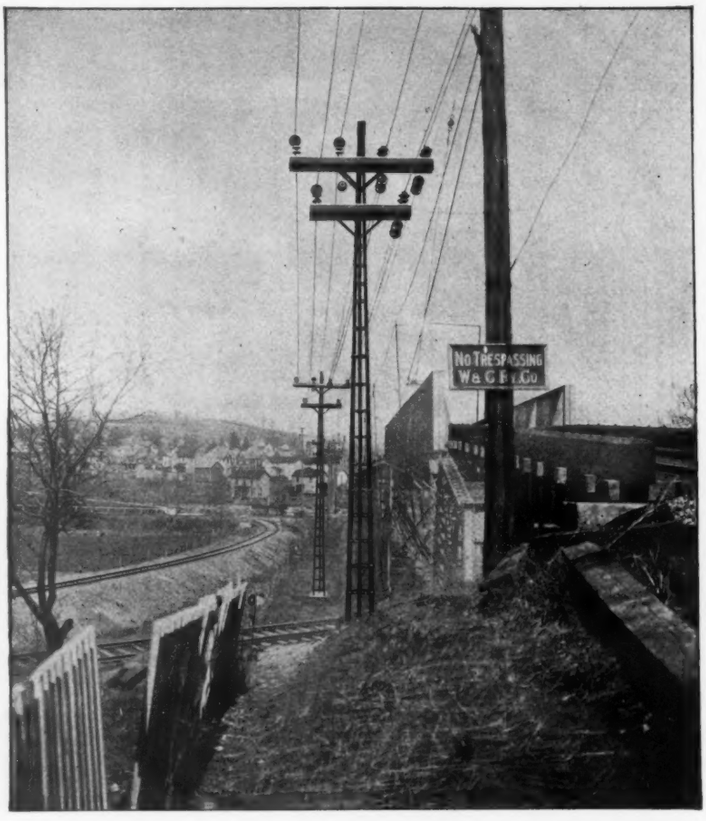
Chicago	**New York**	**Cleveland**
Worcester	**Pittsburgh**	**Denver**

Export Representative: U. S. Steel Products Co., New York. Pacific Coast Representative: U. S. Steel Products Co., San Francisco, Los Angeles, Portland, Seattle.

Steel Poles

Operating Officials who have difficult cross over problems, will find the solution in the Tripartite Steel Poles.

These sturdy, small based structures meet conditions impossible for the usual type of structural tower.



Franklin Steel Works

Franklin, Penna. U. S. A.

New York Office, 30 Church St.
Minneapolis Office, Phoenix Bldg.
Denver Office, McPhee Bldg.
San Francisco Office, 530 Golden Gate Ave.

Don't Let Profits Leak Out at Substations

through your transformers. Why strive to save in the boiler room, at the throttle, and in the generator, if you allow all the energy saved to be wasted in excessive transformer losses?

Moloney Transformers

In Units From 100 to 500 K. V. A.

are *high efficiency* transformers. Their silicon steel cores insure lowest core losses, and the large cross-section of copper insures minimum copper losses. Perfect insulation and low temperature rise insure safety and long life to every Moloney Transformer — the transformer for *economy in service*. Write for the Moloney Catalog.

MOLONEY ELECTRIC COMPANY

Main Office: St. Louis, Mo. **Factories: St. Louis, Mo., and Windsor, Ontario**

DIRECT OFFICES:
1716 Fisher Bldg., Chicago, Ill.
655 Mission St., San Francisco, Cal.
400 Lake-of-the-Woods Bldg., Montreal, Que.
1001 C. P. R. Bldg., Toronto, Ont.
901 Elec. Ry. Chambers, Winnipeg, Man.

AGENTS:
C. A. Milbank, 304 R. A. Long Bldg., Kansas City, Mo.
Jno. S. Black, 908 Hennen Bldg., New Orleans, La.
E. B. Day, 512 Arch St., Philadelphia, Pa.
Elliott-Lewis Elec'l Co., Inc., Philadelphia, Pa.
Nixon & Kimmel Co., Spokane, Wash.

Harmon S. Salt, 114 Liberty St., New York, N. Y., Special Representative.

76.0

Keeping the "Juice" on the Line

Said an official of the Pennsylvania Railroad to a sub-station operator, "Young man, it's your job to keep the 'juice' on the rails."

It's the job of

Pennsylvania R. R. Harrison cut-off line. Standard straight line tower with No. 2233 and No. 2232, "Victor" Insulators.

"VICTOR" INSULATORS

Pennsylvania R. R. Harrison cut-off line. Hackensack River crossing. Anchorage tower with No. 2230 "Victor" Insulators.

to keep the "juice" on the line, and so well do they perform their task that they were chosen to fulfill their important function for the Pennsylvania R. R., and they are now keeping the "juice" on the lines of that railroad's electric zone. A few reasons for Victor efficiency are included in the Insulator Book. Get it.

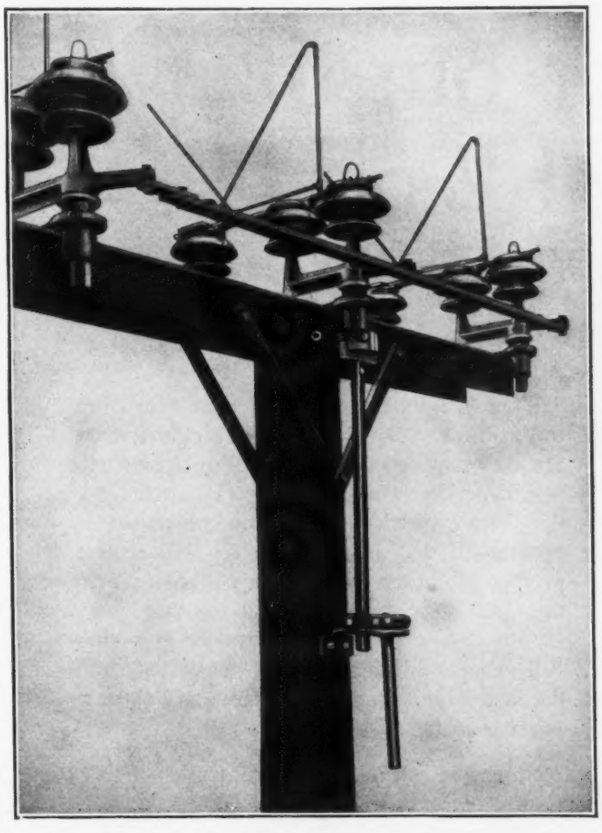
The Locke Insulator Mfg. Co.

Main Office, Victor, N. Y. **N. Y. City, 50 Church St.**

Representatives:

Pierson, Roeding & Co., San Francisco, Seattle, Los Angeles and Portland, Ore.
Pettingell-Andrews Co., Boston.
Electric Service Supplies Co., Chicago and Philadelphia.
Union Electric Co., Pittsburgh.
Inter-Mountain Electric Co., Salt Lake City.
Engineering Equipment & Supply Co., Montreal.
Wm. Geipel & Co., London, England.

7624



Why you should use Burke Horn Gap Switches

BECAUSE —Every transmission line should be sectionalized.

BECAUSE —Provision should be made outside every sub-station to disconnect in case of fire.

BECAUSE —They are adapted to this service. They open under heavy load.

BECAUSE —You can obtain nothing better than the Burke Switch, which has been refined through years of service.

Railway & Industrial Engineering Co.

Pittsburgh, Pa.

Address Correspondence,
Works Office, Greensburg, Pa.
New York Agency: 50 Church Street

PRESSED STEEL CASES

This is the *most important* advance in transformers for many years.

Pittsburgh Transformer Company

PITTSBURGH, PA.

Write for Bulletin No. 1280

SALES AGENTS

Delta-Star Electric Company, Chicago.
Rumsey Electric Company, Philadelphia.
Stuart-Howland Company, Boston.
Iron City Electric Company, Pittsburgh.
A. Hall Berry, New York.
Interstate Electric Company, New Orleans.
Jaspersen Supply Company, St. Marys, O.
Federal Sign System (Electric), Chicago, New York, San Francisco.
Verne W. Shear & Co., Akron,
The Korsmeyer Company, Lincoln, Neb.

What you get out of *your* Electrical World

depends upon the time and thought you put into the reading of it.

Thought, time, energy and money are expended in abundance to make each issue of maximum value to the greatest possible number of readers. You benefit by this expenditure in direct proportion to the attention which you give to your paper.

A mind alert for suggestions will find in every issue food for thought and help in its daily tasks. This applies to the reading of the advertising pages, as well as to the reading of the text.

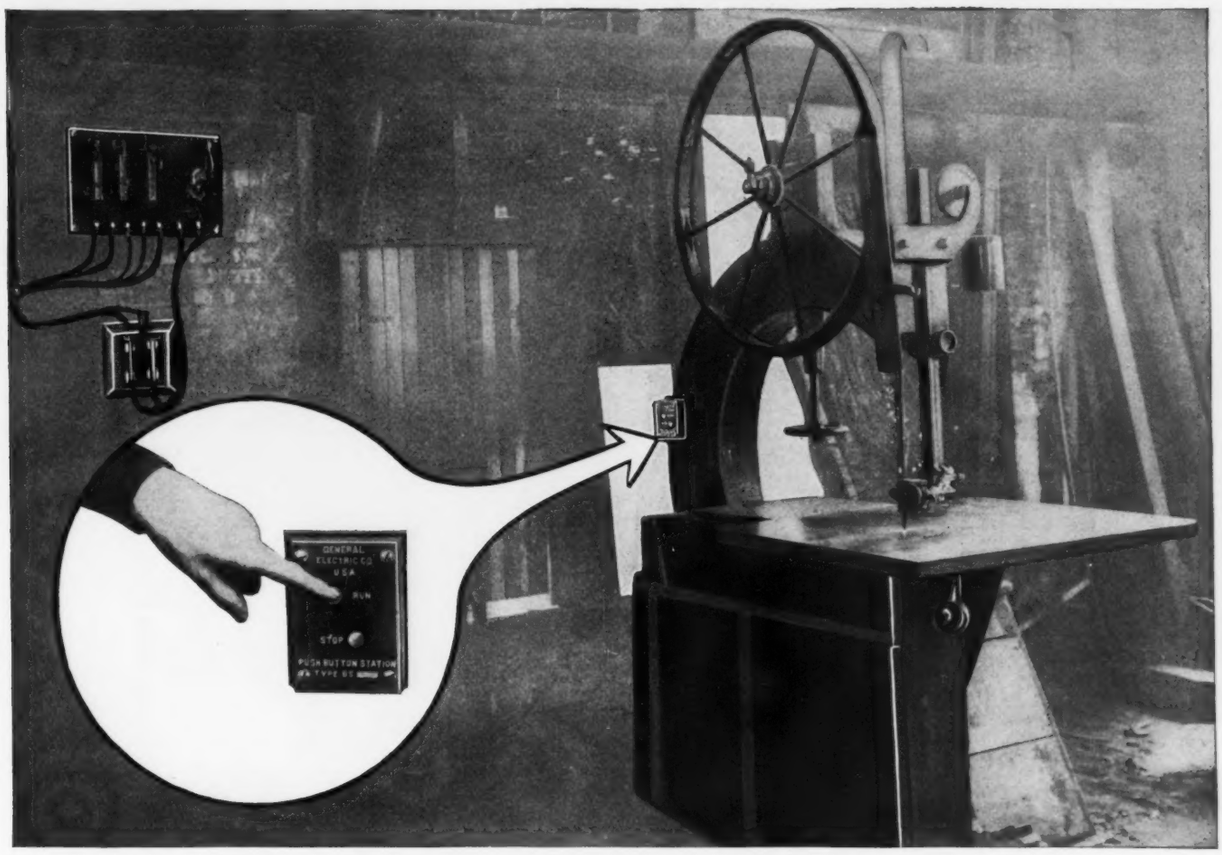
Remember that electrical progress is due as much to the efforts of the electrical engineers engaged in developing new equipment for manufacturers as to those who buy and use what these manufacturers tell about in their advertisements.

These engineers who give their talents to the manufacturing branch of the industry are always ready to give the benefit of their study and experience to their fellows in the field. An inquiry addressed to the advertiser is usually all that is required. It will receive prompt attention whether or not you are in the class of potential buyer at the time.

Advertisers know the advantage of giving full and reliable information to everybody in the field who indicates his interest in anything relating to the advertised product.

Electrical World, 239 West 39th Street, New York

Member Society for Electrical Development. "Do It Electrically."



G-E Industrial Control operating direct current motor on band saw in a wood working plant.

PUSH THE BUTTON

and the G-E control panel on the wall starts the electric motor on this band saw.

It starts correctly—without depending upon the experience or judgment of the operator. When power goes off the line, the saw stops and will not start until the button is pushed again. The no-voltage release which furnishes this protection for the man at the saw, is only one of the many advantages of modern G-E control.

G-E INDUSTRIAL CONTROL

saves expense, by maintaining continuous production, protects the operator and practically eliminates electrical repairs. Power is saved also—for the operator is more apt to shut down the motor when not in use.

Inquiries from "Safety First" Committees, welfare workers and others interested in the protection of men as well as machines will be cheerfully answered.

SAFETY FIRST

Industrial Control

G-E Industrial Control can be furnished for the practical and economical operation of any motor anywhere.

Call, write or telephone our nearest office for further details and special information on our exchange proposition.

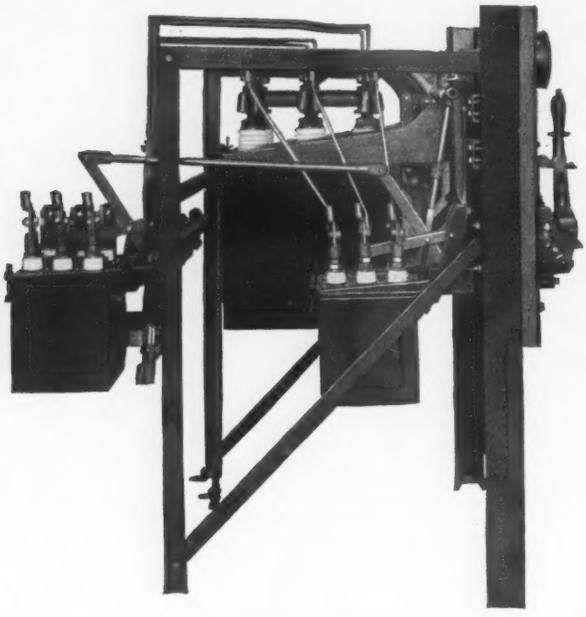
General Electric Company

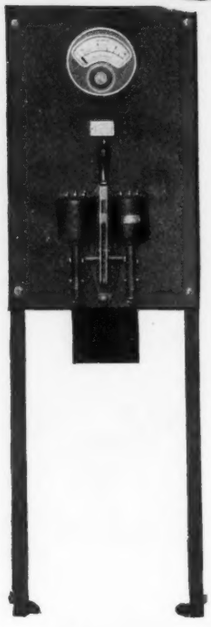
List of Sales Offices on Second Page Before Editorial Section

4021

The Trade Mark of the Largest Electrical Manufacturer in The World.

This Trade Mark The Guarantee of Excellence on Goods Electrical.





"Standard Unit" Motor Panels

for Controlling and Protecting Three-Phase Induction Motors

One of the most popular lines of G-E "Standard Unit" Panels is a line of induction motor panels. These panels are suitable for installation near the motors. Where necessary, interlocks are provided to prevent switches being operated in incorrect sequence. Panels are furnished with or without ammeter and low voltage release, as desired.

For squirrel cage motors up to 200 horsepower and for internal resistance motors up to 4,000 horsepower, the complete equipment is listed under one catalogue number and can be ordered direct from our Bulletin A4178.

Other panels are listed for external resistance motors and for squirrel cage motors up to 4000 horsepower, but for the first case, controllers, and for the second case, starting compensators or auto-transformers must be added to the regular panel equipment.

Our Bulletin A4178 describing all these panels will be sent on request.

Select your Switchboard Panels from a G-E Bulletin

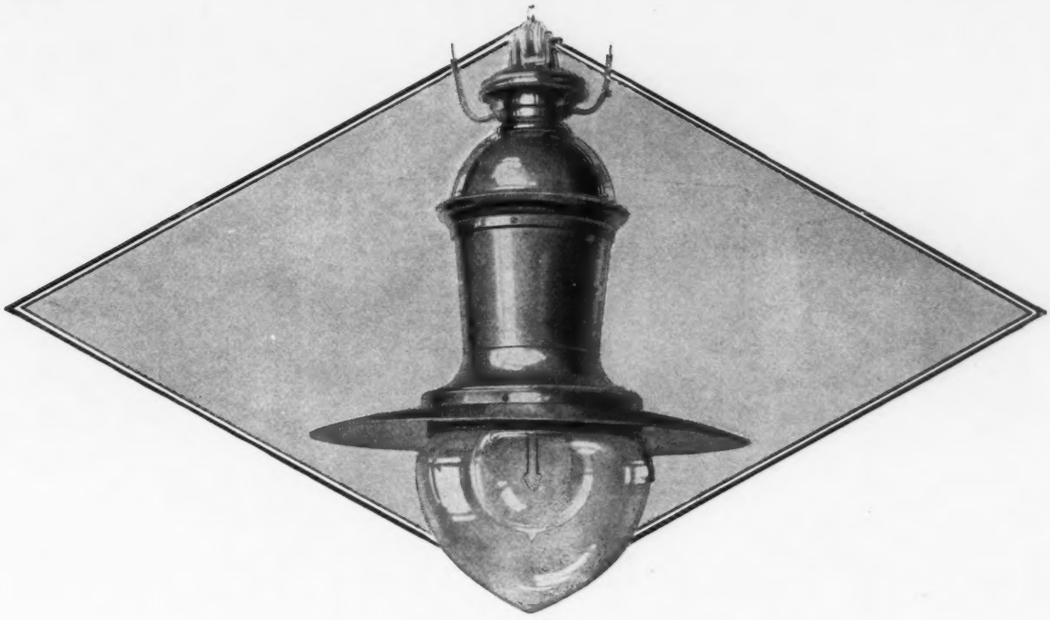
General Electric Company

List of Sales Offices on Second Page Before Editorial Section

4995

The Trade Mark of the Largest Electrical Manufacturer in The World.

The Trade Mark of the Largest Electrical Manufacturer in The World.



Novalux

"Novalux" is the new name given to all G-E pendent and ornamental units wherein the new sizes of series MAZDA Lamps are used.

Maximum efficiency of these new high candle-power lamps is obtained at high current values. To get this high current for efficient street lighting the Novalux compensator unit has been especially designed.

It contains an individual compensator for correct operation of the 20 ampere lamps on 6.6 and 7.5 circuits—saving about 25% of the energy required for straight series.

In addition to the excellent efficiency obtained, the design of the compensator is such that regulation is very appreciably improved.

There are two sizes of compensators used with the 600 and 1,000 c.p. 20 ampere Series MAZDA Lamps respectively; they are equipped with taps for either 6.6 or 7.5 ampere series alternating current circuits.

The efficiency of these compensators is about 95% with a power factor of 98.

NOVALUX

To obtain the most satisfactory operation and the greatest value from these new high candle-power lamps use Novalux self-contained compensator pendent units for street series lighting.

General Electric Company

List of Sales Offices on Second Page Before Editorial Section

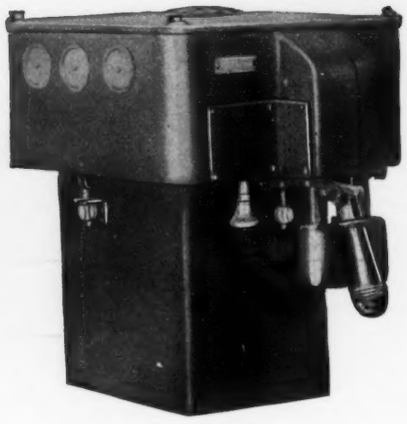
5086

This Trade Mark The Guarantee of Excellence on Goods Electrical.

This Trade Mark The Guarantee of Excellence on Goods Electrical.

P-3, Non Automatic

P-6, Automatic Overload



K-20, Automatic Overload with low voltage release

Three Successful Oil Switches Used in Industrial Plants

For industrial service these three closely related oil switches contain every essential for safe and satisfactory service. They are first-class in every detail and are used with great success in all kinds of plants, for starting, stopping and protecting induction motors which can be thrown directly on the line.

Easy to Install

They are compact and arranged for wall or post mounting, with either open or conduit wiring

Strong Operating Mechanism

The operating mechanism is simple and strong. The switch will not be damaged when operated by unskilled labor.

Maximum Life to Contact Surfaces

They are equipped with the famous sliding wedge type of contact.

Fire Hazard Reduced to a minimum

They are entirely enclosed, the leads under the cover, and the contacts under oil. This is essential where explosive gases or inflammable material are prevalent.

PROTECTION

In addition, the automatic switches, P-6 and K-20, are equipped with inverse time limit dash pot trip, the coils of which are *always* in circuit. The time limit dash pot insures tripping on sustained overload and prevents the motor from running single-phase, but allows it to draw the necessary current on starting.

A low voltage release is furnished when desired, which trips the switch either on the failure of voltage on the line or when reduced to approximately 50 per cent of normal.

Overload and low voltage trip coils are absolutely independent of one another and trip the switch by direct mechanical connection with the operating mechanism.

The P-3, P-6 and K-20 oil switches are safe, reliable, durable and convenient.
Complete details in Bulletins A-4113 and 4911.

General Electric Company

List of Sales Offices on Second Page Before Editorial Section

4947

The Trade Mark of the Largest Electrical Manufacturer in The World.

The Trade Mark of the Largest Electrical Manufacturer in The World.

This page is prepared for the ready reference of the readers of the Electrical World. To insure correspondence against avoidable delay, all communications to the company should be addressed to the sales office nearest the writer.

General Electric Company

Sales Offices

ATLANTA, GA., Third National Bank Building.
BALTIMORE, MD., Electrical Building.
BIRMINGHAM, ALA., Brown-Marx Building.
BOISE, IDAHO, Idaho Building.
BOSTON, MASS., 84 State Street.
BUFFALO, N. Y., Electric Building.
BUTTE, MONTANA, Electric Building.
CHARLESTON, W. VA., Charleston National Bank Bldg.
CHARLOTTE, N. C., Commercial National Bank Bldg.
CHATTANOOGA, TENN., James Building.
CHICAGO, ILL., Monadnock Building.
CINCINNATI, OHIO, Provident Bank Building.
CLEVELAND, OHIO, Illuminating Building.
COLUMBUS, OHIO, Columbus Savings & Trust Bldg.
DAYTON, OHIO, Schwind Building.
DENVER, COLO., First National Bank Building.
DES MOINES, IA., Hippee-Polk Building.
DETROIT, MICH., Dime Savings Bank Bldg., (Office of Agent)
ELMIRA, N. Y., Hulett Building.
ERIE, PA., Marine National Bank Building.
FORT WAYNE, IND., Fort Wayne Works.
HARTFORD, CONN., Hartford National Bank Building.
INDIANAPOLIS, IND., Traction Terminal Building.
JACKSONVILLE, FLA., Heard National Bank Bldg.
JOPLIN, MO., Miners' Bank Building.
KANSAS CITY, MO., Dwight Building.
KNOXVILLE, TENN., Bank & Trust Building.
LOS ANGELES, CAL., 124 West Fourth Street.
LOUISVILLE, KY., Starks Bldg.
MEMPHIS, TENN., Randolph Building.
MILWAUKEE, WIS., Public Service Building.
MINNEAPOLIS, MINN., 410 Third Ave., North.
NASHVILLE, TENN., Stahlman Building.
NEW HAVEN, CONN., Second National Bank Bldg.
NEW ORLEANS, LA., Maison-Blanche Building.
NEW YORK, N. Y., 30 Church Street.
NIAGARA FALLS, N. Y., Gluck Building.
OMAHA, NEB., Union Pacific Building.
PHILADELPHIA, PA., Witherspoon Building.
PITTSBURG, PA., Oliver Building.
PORTLAND, ORE., Electric Building.
PROVIDENCE, R. I., 1012 Turks Head Building.
RICHMOND, VA., Railway and Power Building.
ROCHESTER, N. Y., Granite Building.
SALT LAKE CITY, UTAH, Newhouse Building.
SAN FRANCISCO, CAL., Rialto Building.
SCHENECTADY, N. Y., G-E Works.
SEATTLE, WASH., Colman Building.
SPOKANE, WASH., Paulsen Building.
SPRINGFIELD, MASS., Massachusetts Mutual Bldg.
ST. LOUIS, MO., Pierce Building.
SYRACUSE, N. Y., Onondaga County Savings Bank Bldg.
TOLEDO, OHIO, Spitzer Building.
WASHINGTON, D. C., Evans Building.
YOUNGSTOWN, OHIO, Wick Building.

For TEXAS, OKLAHOMA and ARIZONA Business refer to Southwest General Electric Company (formerly Hobson Electric Co.)
DALLAS, TEX., 1701 No. Market St.
HOUSTON, TEX., Third and Allen Sts.
EL PASO, TEX., 500 San Francisco Street.
OKLAHOMA CITY, OKLA., Insurance Building.

For all CANADIAN Business refer to CANADIAN GENERAL ELECTRIC Co., Ltd., Toronto, Ont.

FOREIGN OFFICES OR REPRESENTATIVES:

Argentina. Cia. General Electric Sudamericana, Inc., Buenos Aires; **Australia:** Australian General Electric Co., Sydney and Melbourne; **Brazil:** Companhia General Electric do Brazil, Rio de Janeiro; **Central America:** G. Amsinck & Co., New York, U. S. A.; **Chile:** International Machinery Co., Santiago, and Nitrate Agencies. Ltd., Iquique; **China:** Andersen, Meyer & Co., Shanghai; **Colombia:** Wesselhoeft & Wisner, Barranquilla; **Cuba:** Zaldo & Martinez, Havana; **England:** General Electric Co. (of New York), London; **India:** General Electric Co. (of New York), Calcutta; **Japan** and **Korea:** General Electric Co. and Bagnall & Hilles, Yokohama; Mitsui Bussan Kaisha, Ltd., Tokyo and Seoul; **Mexico:** Mexican General Electric Co., Mexico City; **New Zealand:** National Electric & Engineering Co., Wellington, Dunedin and Auckland; **Peru:** W. R. Grace & Co., Lima; **Philippine Islands:** Frank L. Strong Machinery Co., Manila; **South Africa:** South African General Electric Co., Johannesburg, Capetown and Durban.

General Offices, Schenectady, N. Y.

Products and Purpose

The General Electric Company is the largest electrical manufacturer in the world. With few exceptions its products comprise every kind of apparatus and machinery used in the generation, transmission, distribution and use of electrical energy. Its thousands of products, in use in all parts of the world, have established the G-E Trade Mark as the Guarantee of Excellence on Goods Electrical. As in the past the General Electric Company will continue to be foremost in all developments and improvements tending toward the perfection of present electrical service and its extension into new fields of usefulness.

4524

Member of the Society for Electrical Development, Inc.

"DO IT ELECTRICALLY"

This Trade Mark The Guarantee of Excellence on Goods Electrical.

KERITE

KERITE INSULATED WIRE & CABLE COMPANY
NEW YORK CHICAGO

Weber Universal Electrolier Sockets

THESE SOCKETS ARE DESIGNED
FOR USE ON FIXTURES ONLY
FOR THIS PURPOSE
THEY ARE PRE-EMINENT

THEY HAVE ALL THE VALUABLE
FEATURES OF THE STANDARD

WEBER UNIVERSAL SOCKETS

SO WELL AND FAVORABLY KNOWN
THE SHELLS AND CAPS
ARE, HOWEVER,
SHORTER AND SMALLER IN DIAMETER

For sale by

ALL JOBBERS OF ELECTRICAL SUPPLIES

HENRY D. SEARS, General Sales Agent, 131 State St.,
Boston, Mass. 5

OKONITE — TRADE MARK REG. U.S. PAT. OFF.

The STANDARD *for* RUBBER INSULATION

OKONITE INSULATED WIRES AND CABLES

can be depended upon to meet the most exacting requirements of lighting or power service, economically and profitably.

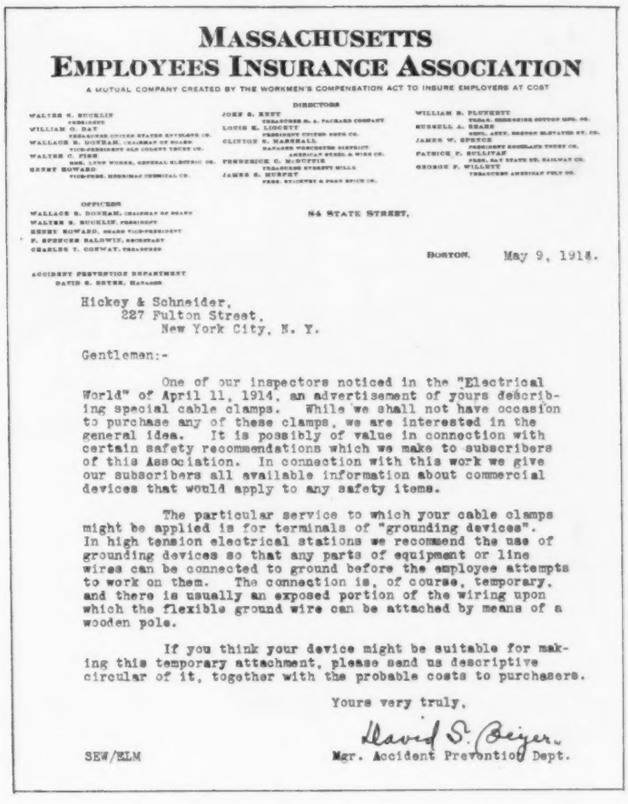
15

THE OKONITE COMPANY

253 BROADWAY, NEW YORK

PUBLISHER'S PAGE

Electrical World Advertisement Helps "Safety First" Movement



MASSACHUSETTS EMPLOYEES INSURANCE ASSOCIATION

A MUTUAL COMPANY CREATED BY THE WORKMEN'S COMPENSATION ACT TO INSURE EMPLOYERS AT COST

DIRECTORS

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F. SPENCER BALDWIN, SECRETARY
CHARLES T. CONWAY, TREASURER

84 STATE STREET,

BOSTON, May 9, 1914.

ACCIDENT PREVENTION DEPARTMENT
DAVID S. BEYER, MANAGER

Hickey & Schneider,
227 Fulton Street,
New York City, N. Y.

Gentlemen:-

One of our inspectors noticed in the "Electrical World" of April 11, 1914, an advertisement of yours describing special cable clamps. While we shall not have occasion to purchase any of these clamps, we are interested in the general idea. It is possibly of value in connection with certain safety recommendations which we make to subscribers of this Association. In connection with this work we give our subscribers all available information about commercial devices that would apply to any safety items.

The particular service to which your cable clamps might be applied is for terminals of "grounding devices". In high tension electrical stations we recommend the use of grounding devices so that any parts of equipment or line wires can be connected to ground before the employee attempts to work on them. The connection is, of course, temporary, and there is usually an exposed portion of the wiring upon which the flexible ground wire can be attached by means of a wooden pole.

If you think your device might be suitable for making this temporary attachment, please send us descriptive circular of it, together with the probable costs to purchasers.

Yours very truly,

David S. Beyer.

SEW/ELM Mgr. Accident Prevention Dept.

READ the letter shown above. Note how an Electrical World advertisement helped the Massachusetts Employees Insurance Association to protect its subscribers.

The result of the investigation started by this letter is stated by the advertisers, Hickey & Schneider, who wrote us:

"We have received quite a number of orders and inquiries through this Association having noted our advertisement."

From the advertiser's viewpoint, it serves to emphasize the wide variety of influences set to work by Electrical World advertising. The electrical industry is made up of many classes, all interested in the Electrical World and all possible factors in influencing sales, directly or indirectly.

From the readers' viewpoint, the incident emphasizes the great variety of useful ideas which may be gleaned by reading the advertising pages. Frequently readers discover uses for advertised products which are not mentioned, and perhaps not even thought of, by the advertiser.

"What use can I make of this?" would be a good question for every reader to apply to every advertisement in every issue of the Electrical World.

It pays. It paid the inspector who saw the cable clamp advertisement, it paid the manager of the Association's accident prevention department, it paid the association and its subscribers, and it paid the advertiser.

"MEGGER" Testing Sets

Megger Testing Set of latest type

To determine condition of large transformers, generators, and other heavy equipment during "drying out" is one of the numerous tests for which "Meggers" greatly excel all other devices.

In this connection, our customers say:

(1) "We have used the Megger for indications during drying out of the generators, motors and transformers."

(2) "We have used the Megger-method a great many times in determining the condition of transformers during the drying-out process."

(3) "We have used the Megger-method for determining the condition of large transformers during the process of drying-out with entire satisfaction."

(4) "The Megger is now our standard for determining the condition of insulation after the drying-out process, and is the most convenient method with which I am familiar."

(5) "The Megger-method is much more convenient than the volunteer method and is certainly very superior to any apparatus requiring a reflecting galvanometer."

The Megger suitable for the above conditions can also be used for measuring insulation resistance of high and low tension cables, and for periodic insulation tests of power house or substation apparatus, as well as high tension insulators.

Write today for our new illustrated descriptive **Catalog 786,** *just issued. It tells about Meggers, Bridge-Meggers and the Megger-method of testing.*

"DO IT ELECTRICALLY"

JAMES G. BIDDLE
1211-13 Arch Street
Philadelphia

"DO IT ELECTRICALLY"

Be Sure to Visit Our Permanent Exhibit.

Simplex Electric Ranges

are admitted the perfection of cooking equipment. Free from ashes—require no fuel—cause no heat. Economical and practical.

SIMPLEX QUALITY

Send for booklet
4 Recipes for Happiness

Simplex Electric Heating Co.
Mfrs. of Everything for Electric Heating and Cooking
Cambridge, Mass.

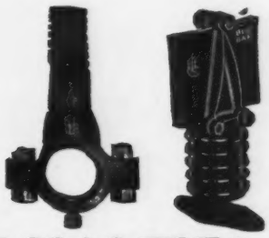
15 So. Desplaines St., Chicago

612 Howard Street, San Francisco, Cal.

Belleville, Ont.

BY INVITATION MEMBER OF

Member of The Rice Leaders of the World Association



HIGH TENSION SPECIALTIES OF EVERY DESCRIPTION

SOLD UNDER A 5 YEARS' GUARANTEE

SHIPPED AT ONCE ON RECEIPT OF ORDER

Write for One of these Catalogs

You will find the data, tables and general information of decided value.

A handy book to have on your desk

All material manufactured under laboratory control and tested on 3 to 5 times the indicated line voltage to insure absolute dependability under all service conditions.

We can supply you with standard equipment at once and special material on very short notice.

All copper castings are 95 per cent. pure copper insuring high conductivity and cool operation.

"Shrink fit" fittings of every description, 95 per cent. pure copper are used in connection with tubular buses.

We shall be pleased to send anyone on request our catalog and also Bulletin 101 describing indoor, outdoor and pole-top disconnecting switches.

ELECTRICAL ENGINEERS EQUIPMENT CO.

711-715 Meridian St., Chicago, Ill.

Northern Electric Company
LIMITED
Canadian Agents.

Western Electric Co., Distributors.
J. C. Farrar, Los Angeles, Cal., Pacific Coast Agents.

1

PARANITE

Rubber Covered Wires and Cables

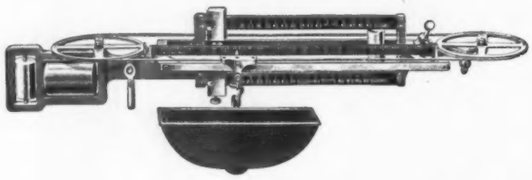
are made for Underground, Submarine, and Aerial Electric Light and Power Service, and for Telephone, Telegraph, Fire Alarm and Signal Work.

They conform in every respect to the requirements of the New Code Specifications. Best results will be secured if you confer with us before placing your order for wires or cables

INDIANA RUBBER & INSULATED WIRE CO.

JONESBORO, IND.

1



There must be Something to It

When 3,000 manufacturers in over 100 different lines of business have adopted the

National Factory System

for Counting duplicate parts and Trucking finished or unfinished material in their establishments.

By means of this method at least half the present cost of performing these operations can be saved. Much time, labor, material and money that previously aided the lost profit side of the ledger may also be saved.

National Counting Machines

built in twenty-two different models, accurately count duplicate pieces in the fastest manner possible. They give gross, tare and net weight and are designed to count in units, dozens, gross, feet, yards or liquid measure.

National Chapman Elevating Trucks eliminate the necessity of rehandling material to be moved through and around the different departments. Loading directly on skids which are picked up by the elevating truck and lowered at the next operation by pressing a foot lever, and keeping the material on skids continually until finished, means a saving in time, a saving in material, and saving in operating cost and floor space.

Built in nine standard models. Special models for special requirements. A post card will bring our catalog "E. W." and other valuable information on cutting factory costs. Write for it to-day.

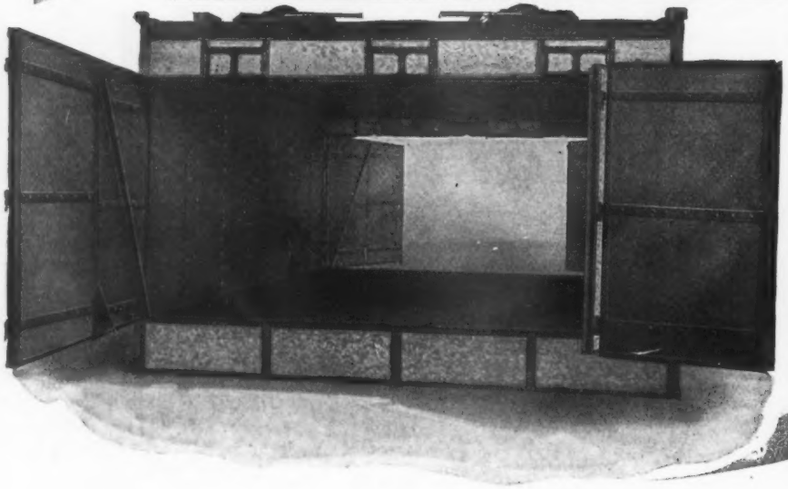
National Scale Company

234 E. West St., Chicopee Falls, Mass.

You Can Double Your Output

of well-dried coils or armatures if you cut in half the time necessary for drying. You can do this only with the type of oven which can be filled to the top—which heats the product evenly all over—which provides adequate circulation. You can do it by using the

CRAWFORD Sectional Oven



With the patented **Enclosed Flame Gas Burner,** this oven will give you equally good results whether filled to the roof with material, or only partially filled. The positive forced circulation gives the heat treatment—uniformly—in every part of the oven.

If you are having the slightest trouble with your oven equipment, let us confer with you.

Catalog 4 sent at your request.

The Oven Equipment & Mfg. Co.
New Haven, Conn.

54-49

KANDEM
Flaming Arc Carbons

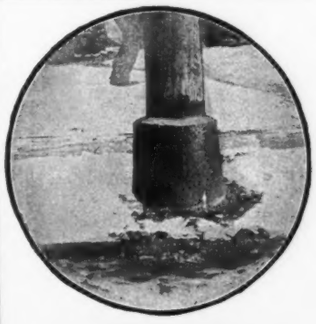
These special carbons are correct in diameter, cross section, length, have perfect cores, smooth, even surfaces which permit regular feeding with absence of flickering.

Specially manufactured for the manufacturers of

THE EXCELLO LAMP

Send trial order, any dealer or direct to

The Koerting & Mathiesen Co.
22 East 21st Street, New York City



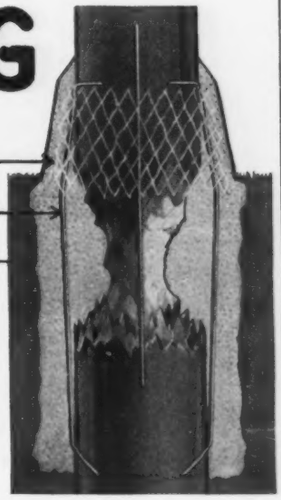
10,000 Miles of Decayed Poles Reclaimed Last Year. Were Yours Among Them?

In a single year an aggregate saving of hundreds of thousands of dollars, in replacement cost alone, was effected by reclaiming decayed poles by

ORR PATENTED REINFORCING

Moreover, the poles so treated will give years of additional service because decay at the ground line is arrested. This means virtually the elimination of pole maintenance expense. No matter how badly decayed before treatment, Orr Reinforced poles are stronger than new.

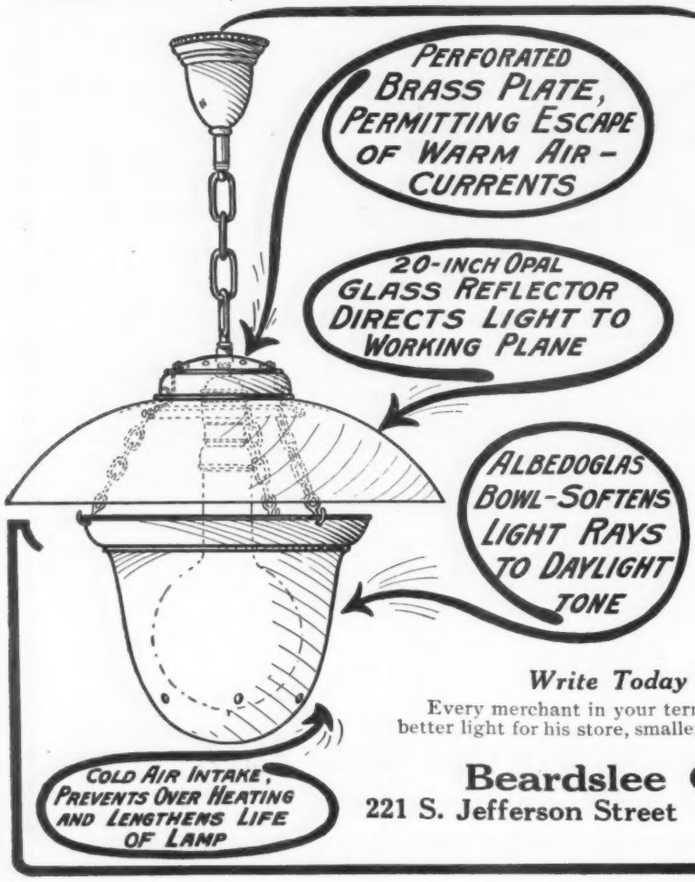
Orr Reinforcing costs but a third the price of a new pole. Get *your* percentage of the saving this year. Write for particulars.



The Hardware MAKES the Line — Hubbard Makes THE Hardware

HUBBARD AND CO
Pittsburgh, Penna.

8503


PERFORATED BRASS PLATE, PERMITTING ESCAPE OF WARM AIR-CURRENTS
20-INCH OPAL GLASS REFLECTOR DIRECTS LIGHT TO WORKING PLANE
ALBEDOGLAS BOWL-SOFTENS LIGHT RAYS TO DAYLIGHT TONE
COLD AIR INTAKE, PREVENTS OVER HEATING AND LENGTHENS LIFE OF LAMP

The Nitrolite

A practical, moderate priced commercial lighting unit for use with the new Nitrogen-filled lamp.

The Nitrolite is a special chandelier for use in dry goods stores, clothing stores, department stores, or anywhere colored fabrics and other materials must be displayed in approximately their daylight values

For Efficient Display Of Merchandise At Night

the Nitrolite stands alone. A 20-inch Opal reflector concentrates the reflected light on the working plane, while the direct light is filtered by means of an Albedoglas bowl. The general effect produced is that of subdued daylight and colored fabrics retain their daylight hue.

Write Today for Prices and Illustrations

Every merchant in your territory will be interested in the Nitrolite. It means better light for his store, smaller current consumption, and the initial cost is small.

Beardslee Chandelier Mfg. Co.
221 S. Jefferson Street CHICAGO, ILLINOIS

The Life of a Lamp Lies in Its Filament

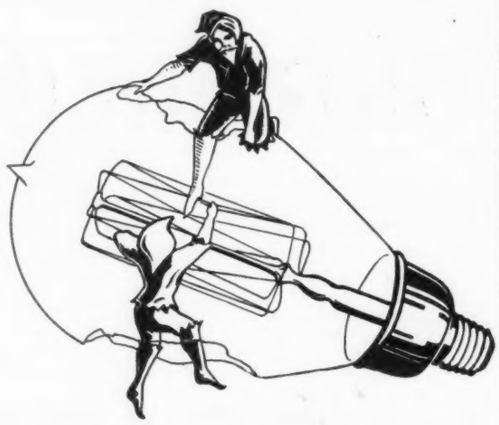
Independent
Ductile Drawn Tungsten Wire

as a filament for tungsten lamps represents a tremendous step in the development of lamp manufacture.

It gives **Independent Lamps** a durability far greater than is obtained with the pressed tungsten filaments.

The Independent not only will resist shock and vibration, destructive to the ordinary lamp, but it furnishes a white light, more nearly approaching daylight than anything yet devised.

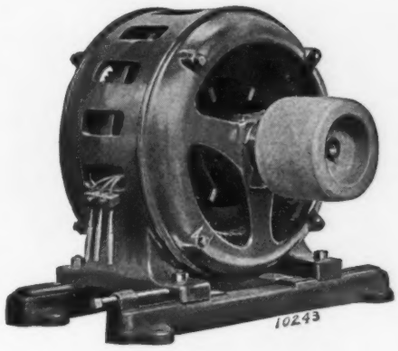
Pick your lamps for long, satisfactory, economical service. Get our details and prices.



The Independent Lamp & Wire Co., 1733 Broadway, New York

Works: York, Pa. and Weehawken, N. J.

8223



Reserve Force—

the ability to stand up in emergency against strains unusually severe, is a characteristic of Allis-Chalmers Induction Motors. Maximum torque and overload capacity ratings are very liberal. This is partially explained by the fact that in their design no sacrifice of materials has been made in an effort to secure a "light" machine.

ALLIS-CHALMERS Induction Motors

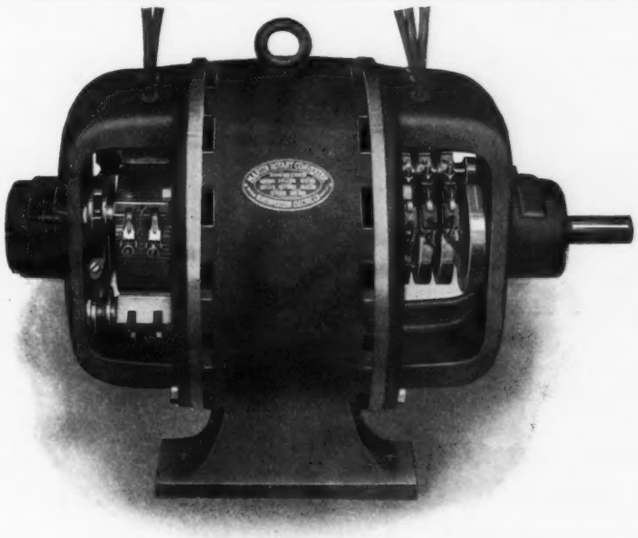
have heavy box-frames pierced with large cored openings which greatly promote cool running. This type of frame is extremely strong and rigid. It also presents a very attractive appearance.

Stator cores are built up of high grade electrical steel punchings specially treated to reduce core loss. Coils are form wound, interchangeable and impregnated with an insulating and waterproof compound.

The rotor has its steel laminations securely mounted on a cast iron spider so shaped as to force air throughout the motor. A very rigid shaft of high carbon steel is pressed into the rotor spider. Liberal bearings of the ring-oiling type, fed from large oil reservoirs, insure a low bearing temperature. These are some of the precautions that are taken to insure the strength and durability of Allis-Chalmers Induction Motors. Better investigate them. Write for Bulletin 1081.

Allis-Chalmers Manufacturing Co. Milwaukee, Wis.

FOREIGN DISTRICT OFFICES:
London, England, 732 Salisbury House, London Wall, E. C.
Santiago, Chile, 87 Galeria Beeche, Casilla, 2653.



How do the Garages of Your City Charge Electric Vehicle Batteries?

How do the "Movies" get Steady White Light that makes the Perfect Projection?

The Martin Rotary Converter

has the high efficiency, perfect regulation and operating economies that appeal to these two classes of users, as well as many others.

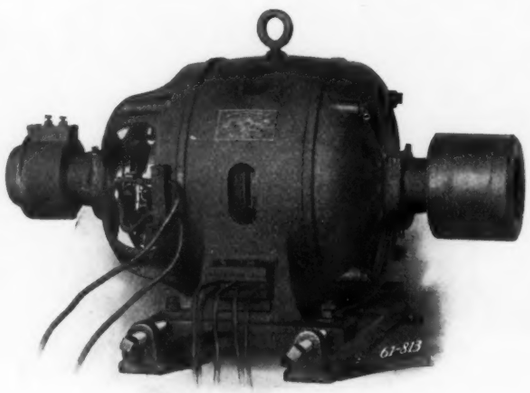
UNITY POWER FACTOR

Built in sizes from 1/6 to 50-K.W. for 110, 220, 440-volt, 25, 30, 60-cycle A. C. lines, single and multiphase; delivering 60-230 volts direct current. Also effectively and economically available to operate electric cranes and electro-magnetic tools. Send for descriptive bulletin, price, etc.

The Northwestern Electric Co., 611-15 West Adams Street CHICAGO

Wagner Unity Power-Factor Motors

will increase your capacity without extra investment. If your system operates at 80% Power-Factor you can only carry sixteen 5 horse induction motors per 100 kw station. At 100% Power-Factor you can carry 20. Hence 25% more Wagner Unity Power-Factor motors than induction motors may be carried in a given generating and transmission system.



Wagner BK (Unity Power Factor) Single-Phase Motor.

Growth of Power Business Means Increased Generating and Transmission Capacity.

Will 25% increase in capacity without extra investment interest you?

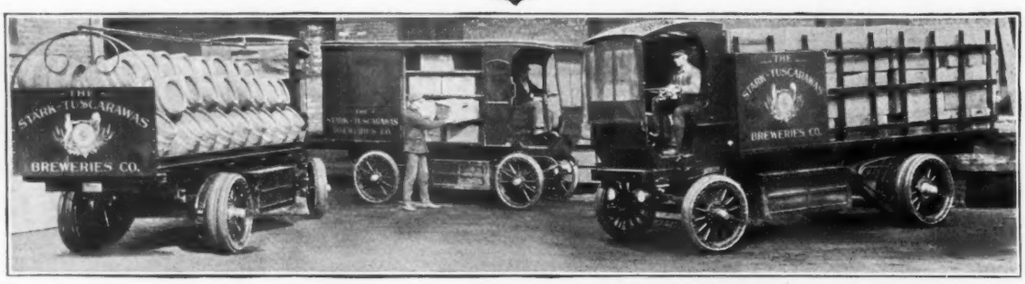
If you can add 25% more power business **without additional investment,** will your gross receipts be greater?

If your gross receipts are greater with no increased investment, will your dividends be greater?

Specify and insist on Wagner Unity Power-Factor motors and you will increase your dividends. Bulletin 1014.

Wagner Electric Manufacturing Company,
Saint Louis, Missouri

Member of Society for Electrical Development. Do it Electrically.



Baker Electric Trucks

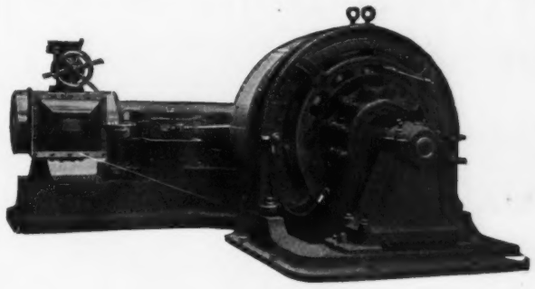
The well known superiority in construction of Baker Electric Trucks insures longer life, lower upkeep cost and more reliable and economical operation than is secured with any other truck in heavy service.

We shall be glad to name eight distinct structural points of superiority in the Baker truck, and give a detailed description of each, on request.

"Electric Trucks Last for Ten Years"

THE BAKER MOTOR VEHICLE CO., CLEVELAND

Baker Electrics



Machines that Co-operate for Profit

Getting maximum profit out of your generating plant is not a matter of buying an engine here and a generator there and hooking them up and operating them. No. Neither machine in itself can earn a dollar. Both together as a **unit** may earn big profits. And the more efficient they are as a **unit** the more profits they can earn.

Ridgway Units

are designed with the idea in mind that generating electrical energy is a **cooperative** enterprise between **two** machines — engine and generator. And the more perfectly they cooperate the higher the efficiency of the **unit**—the greater the profit in their operation. Ridgway engines and Ridgway generators are in themselves individually highly efficient. But when hooked together into the RIDGWAY UNIT they form a power plant the operating efficiency of which means less trouble and greater economy under any and all load conditions to central station men and operators of isolated plants. Write for the Ridgway bulletins.

Ridgway Dynamo and Engine Company
Ridgway, Pa.

7833

Theatres, Hotels, Churches Restaurants, Factories, Etc.

All Need Kimble Ventilation

There's Profit for You in

KIMBLE

Alternating-Current, Variable-Speed, Single-Phase Ventilating

FANS

The only Alternating Current fan that is *variable speed* and *reversible*.

Also the only Alternating Current fan that reduces current consumption in direct proportion to every speed reduction.

An ideal ventilating fan. An easy seller. An excellent profit maker.

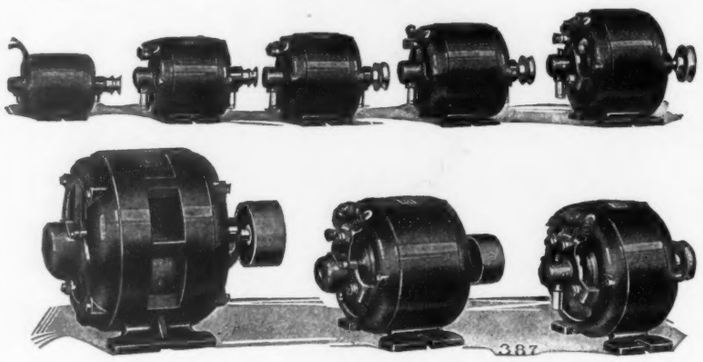
Sell controlled ventilation—*all year round*—but especially *now* at the beginning of the hot months. Make a fine profit on each fan, and let the fans increase your current sales.

Write today for the Red Fan Catalog.

Kimble Electric Co.
The Alternating Current Motor Specialists
637 North Western Ave., Chicago, Ill.

Robbins & Myers Fractional Horse Power Alternating Current Motors

The illustration shows the frames of our type "P" line, 1/60 to ½ horsepower, single-phase. These frames are interchangeable with our Type "N" direct current motors of the same ratings and speeds.



This line can also be supplied with polyphase windings with ratings from ⅛ to 1 horsepower, inclusive.

Whatever you may require in the way of a fractional horsepower alternating current motor, you can get a Robbins & Myers Motor for the work, a motor which is guaranteed to give absolute satisfaction.

BY INVITATION MEMBER OF

THE ROBBINS & MYERS COMPANY

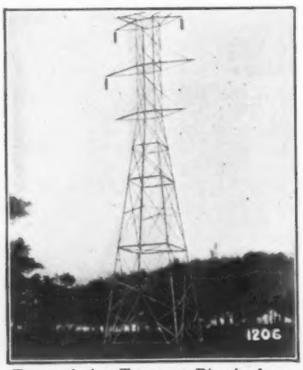
SPRINGFIELD, O.

New York Philadelphia Cleveland Cincinnati
Boston Rochester Chicago St. Louis

The World's largest manufacturer of small motors, 1-60 to 15 H. P. D. C. and 1-60 to 1 H. P. A. C.

AMERICAN BRIDGE COMPANY
HUDSON TERMINAL-30 CHURCH STREET, NEW YORK

Manufacturers of Steel Structures of all classes particularly BRIDGES AND BUILDINGS



Transmission Tower at Birmingham, Alabama, Alabama Power Company.

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Rochester, N. Y. . . . Powers Block
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Cleveland, Ohio . Rockefeller Building
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Pacific Coast Representative:
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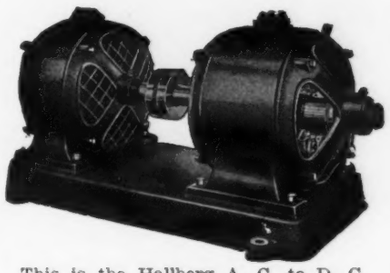
Seattle, Wash., 4th Ave. So. Cor. Conn. St.

Export Representative:
United States Steel Products Co., 30 Church St., N. Y.

Central Station Managers and Electrical Contractors



This is the Hallberg A. C. to D. C. Economizer—It is **not** an ordinary motor generator; it saves 25 per cent more on the bill.

When you have trouble with your consumers and customers about electric bills and the quality of light produced for motion picture theatres, CALL UPON "HALLBERG" for suggestions and the cost of overcoming these difficulties. I have had many years experience in projector arc lighting and can be of considerable service to you. Write today for catalog, but specify Dept. E.

I am distributor of the complete M. P. Equipment.

J. H. Hallberg, 36 E. 23d St., New York, U. S. A.

Anderson Time Switches

combine all good features of switch manufacture

Albert & J. M. Anderson Mfg. Co.
289-293 A Street, Boston, Mass.

2

American Transformer Company

Newark, N. J.

Transformer Engineers and Makers

STAR Soldering Paste

Makes Solder Flow Quickly

This superior paste is strong and rapid in action. It gives perfect satisfaction without deterioration until all used—and it *goes farther* than most pastes. Much time and labor is saved by using STAR. A smooth, evenly flowing metal is assured.

Catalog on request; it shows many McGill Electrical Specialties with price lists.

McGill Mfg. Co., 360 Oak Street Valparaiso, Ind.

Rittenhouse Adjustable Bender

For ½" and ¾" Conduit.

Rittenhouse Co.
Honeoye Falls, N. Y.

Climbers—"Red Devil"—Connectors

Also a full and complete line of electricians' tools.

Pliers, Clamps, Straps, Belts, etc. The largest public service and utilities corporations in the world find it economy to use Red Devils.

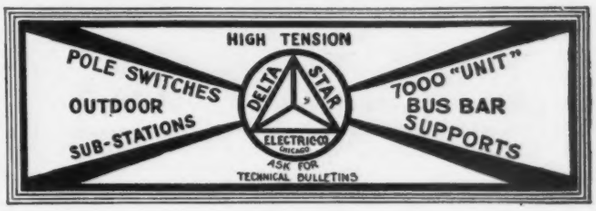
Can you afford not to?

New York SMITH & HEMENWAY CO. Montreal
Largest Mfr. of Electricians' Tools in the World

Can't Separate in the Conduit
COPE CONDUIT RODS

T. J. COPE, 3244 N. 15th St., Philadelphia

Ask for the details of Cope Cable Rack and Conduit Threading Machine.



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CENTRIFUGAL PUMPS
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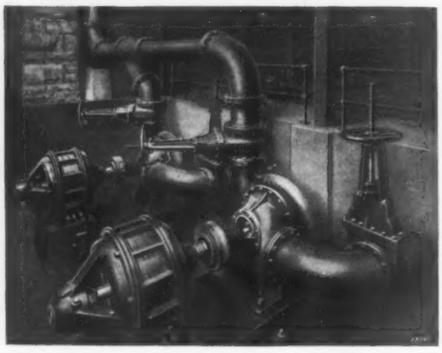

Pumping A Forest!

The Platt Centrifugal Pumps shown above handle every day 12,000,000 gallons of paper pulp at the new Sault Ste. Marie plant of the Lake Superior Paper Co.

Paper Pulp is extremely difficult stuff to pump, because it sticks in and clogs the passages, but the specially designed impeller and casing obviate all such difficulties in this Platt Product, and the work is therefore done at the lowest power cost.

P-36

PLATT IRON WORKS
DAYTON, OHIO AND THIRTY OTHER CITIES

On and Off with One Clock

The A & W
8-day-On-and-Off
Time Switch

will turn your current both on and off at any desired time with no more attention than a weekly winding.

Made in 10 styles to suit the requirements of any service. Open face for indoor, closed face, weather-proof for outdoor use.

A record of four years of uniformly satisfactory service is behind the A. & W

Fully guaranteed.

Write for particulars of our improved models.

The A & W
Electric Sign Company
Cleveland

Time Switches of the bettet sort
Electric Signs Electrical Advertising
8274

Transformers, Compensators and Reactance Coils for Tungsten and Nitrogen Lamps

Kuhlman Electric Co.
Transformer Builders
20 YEARS EXPERIENCE Elkhart, Ind.

We are prepared to furnish
ELECTRIC SEARCH LIGHT PROJECTORS
for all commercial and Government service.
Any Candle power for motor boats, yachts and the largest steam vessels.
Send for catalog A.

The Carlisle & Finch Co.
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There is something thoroughly satisfactory about

No. 264 M. C. Friction Tape

It is so grippy in adhesiveness, so enduring in its friction, so strong dielectrically and mechanically and so handy when on a rush job that only the words "thoroughly satisfactory" describe it.

It is **so satisfactory** that more of this brand is used annually than any other kind of tape on the market.

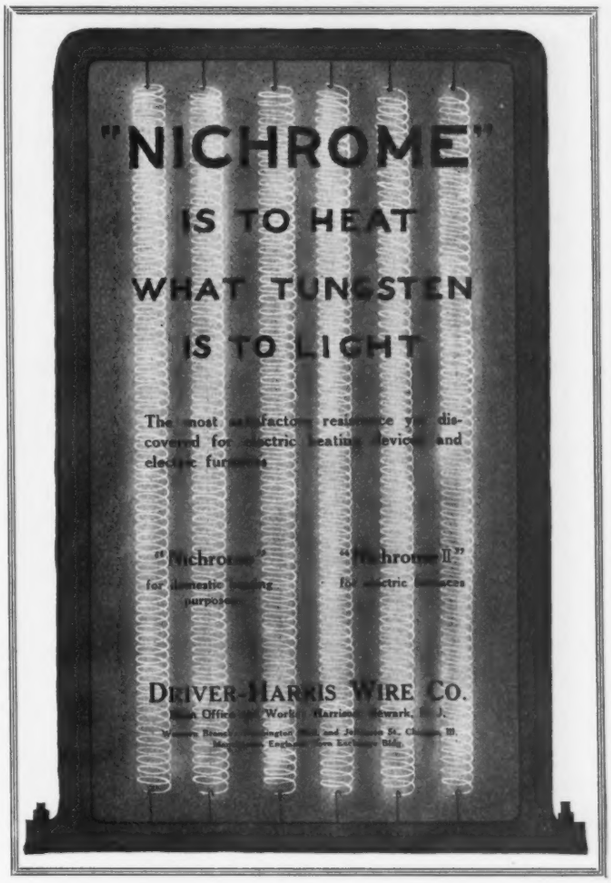
Massachusetts Chemical Co.'s Products

WALPOLE TIRE & RUBBER COMPANY, Walpole, Mass.

Pioneers in Insulation Engineering 10

Liquid and Rubber Insulation

14-132



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Look for the Diamond M

Magnet Wire

We carry a complete stock of cotton, silk and enamel magnet wire in our various warehouses throughout the country.

ALFRED F. MOORE

200 N. Third St., Philadelphia

NEW YORK CLEVELAND CHICAGO BOSTON
CHATTANOOGA NEW ORLEANS

"Tophet" Resistance Wire

A non-corrosive, high-resistance alloy, particularly adapted for use in the construction of Electric Heating Devices or other Resistance Units worked continuously at high temperatures.

Resistance per circ. Mil. Ft. at 75° F. is 600 Ohms.

Write for sample and prices and ask also about "Raymur" and "Apex" Resistance Wires.

Murray Wire Co.

NEWARK, N. J.

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ROME WIRE CO.

ROME, N. Y.

ROUND, SQUARE, FLAT MAGNET WIRE
COTTON, SILK, ENAMEL INSULATIONS

TOOLS

for all classes of electrical construction and repair work. Write for catalog.

Mathias Klein & Sons Canal Station 32 **Chicago**

PENN

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WIRES & CABLES

HAZARD MFG. CO.

WILKES-BARRE, PA. NEW YORK PITTSBURGH CHICAGO

Ask Us to Send You a Sample Weatherproof Socket

When it arrives, look it over thoroughly—note the clean, sharp molding of the heavy waterproof jacket—see how the point where the wires enter is guarded against the entrance of moisture.

We are by far the largest manufacturers of weatherproof sockets in this country, doing all the assembling in our own plant. We keep an eye on every bit of material and every process of manufacture to make sure that our sockets shall give best service.

Shall we send samples?

The Siemon Hard Rubber Corp.
BRIDGEPORT, CONN.

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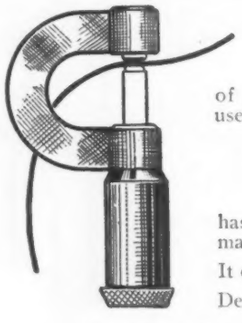
FIELD COILS SOLENOIDS ELECTRO MAGNETS

THE ACME WIRE COMPANY
NEW HAVEN CONNECTICUT



The Uniform Diameter

of "Deltabeston" Magnet Wire is due to the special impregnating and winding apparatus used in its manufacture.

"Deltabeston" Magnet Wire

has an unequalled heat-resisting insulation of asbestos purified by special machinery.

It costs you a higher price per pound, but involves the lowest cost per year.

Details are in our bulletins—get them.

D & W FUSE COMPANY, Providence, R. I.

5

Roebling Wires

for electrical purposes, include annunciator, office, magnet, weatherproof and rubber covered wire, lamp cord, heater cord, telephone and power cables and other electrical wires.

John A. Roebling's Sons Co.
Trenton, New Jersey

New BELDEN Bulletins

Bulletin 1003
Shows over seventy different styles of
Clips, Tips and Terminals
for use on Pigtails, Cords, Miscellaneous Connectors, Etc.

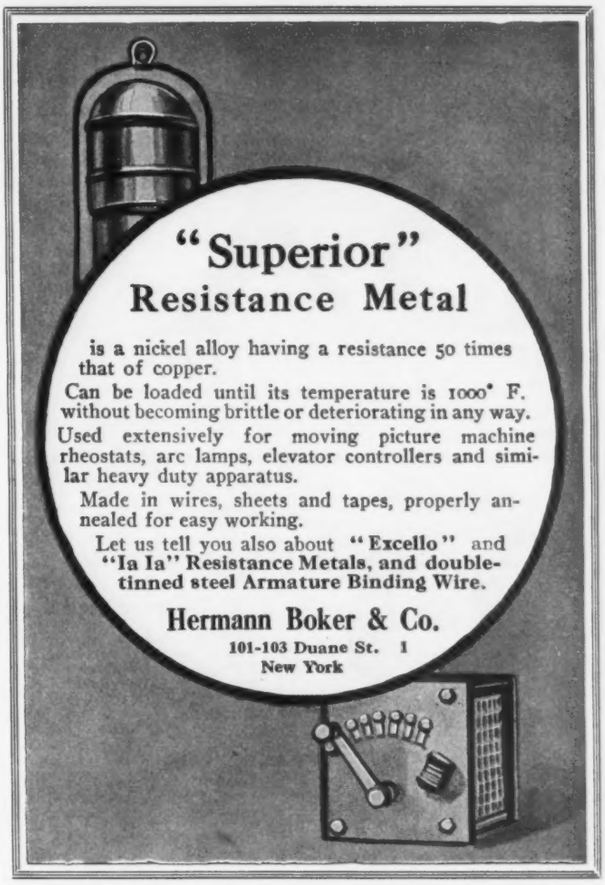
Bulletin 1006
Accurately describes a thoroughly standardized line of
Braided and Stranded Copper Cables
A wide range of sizes carefully graded is listed.

You Need These Bulletins For Your Files

Perhaps they will suggest just the combination for your requirements.

Write today for either or both.

Belden Manufacturing Company
2300 S. Western Ave., Chicago



"Superior" Resistance Metal

is a nickel alloy having a resistance 50 times that of copper.
Can be loaded until its temperature is 1000° F. without becoming brittle or deteriorating in any way.
Used extensively for moving picture machine rheostats, arc lamps, elevator controllers and similar heavy duty apparatus.
Made in wires, sheets and tapes, properly annealed for easy working.
Let us tell you also about **"Excello"** and **"Ia Ia" Resistance Metals, and double-tinned steel Armature Binding Wire.**

Hermann Boker & Co.
101-103 Duane St. 1 New York

THE
National Conduit & Cable Co.
Executive Offices: 41 PARK ROW, NEW YORK, N. Y.

Bare Copper Wire and Cable
Weatherproof Wire and Cable
Office and Annunciator Wire and Cable
Paper Insulated Cable
Power, Telephone, Telegraph

Boston **Philadelphia** **Chicago** **San Francisco**

DOLPHIN
INSULATED WIRE

Notable for its uniformly high quality and dependability.

ATLANTIC INSULATED WIRE & CABLE COMPANY
Sales Office:
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DOLPHIN ATLANTIC
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The American Brass Co.
BENEDICT & BURNHAM BRANCH
Successors to
THE HOLMES, BOOTH & HAYDENS CO.
WATERBURY, CONN.

SUPERIOR WEATHER PROOF "K.K." TRADE MARK ELECTRIC WIRES

Manufacturers of
"K.K." Weatherproof Wire and Cable
Bare Copper Wire and Cable
Slow Burning Weatherproof
Office Annunciator and Magnet Wire

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IN ALL FORMS
FOR ALL PURPOSES
SCRAP PURCHASED
THE ROESSLER & HASSLACHER CHEM. CO.
N. Y. OFFICE 100 WILLIAM ST. — FACTORY PERTH AMBOY, N. J.

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If you remember the slogan
If it's BX, it's Sprague
And specify and insist on the genuine and original flexible steel armored cable.
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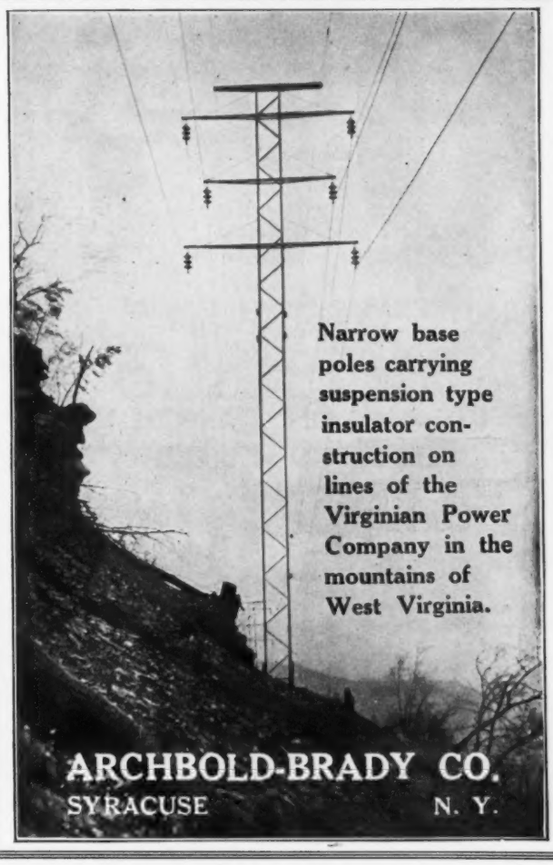
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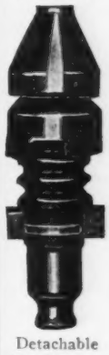

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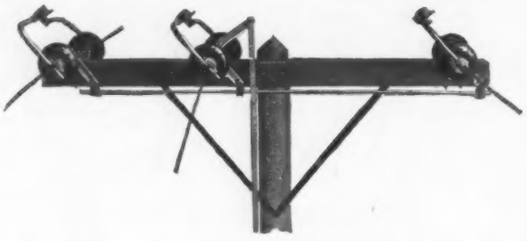

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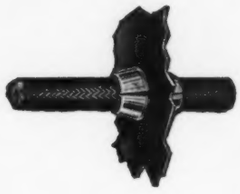

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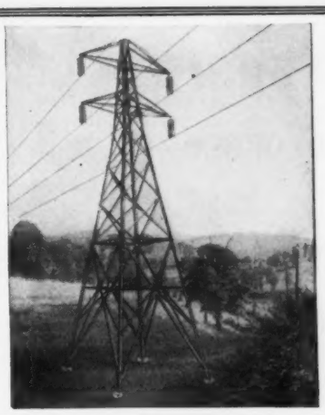

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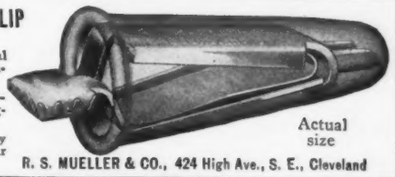

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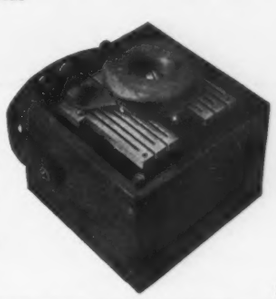

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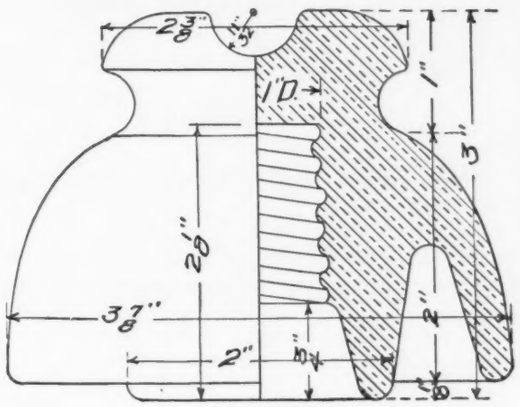

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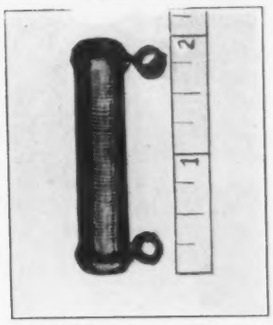

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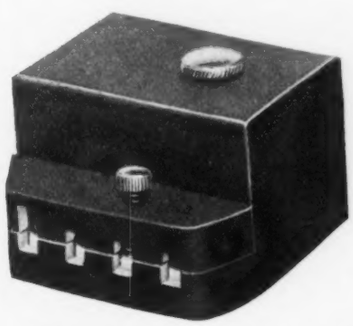

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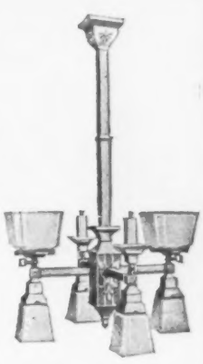

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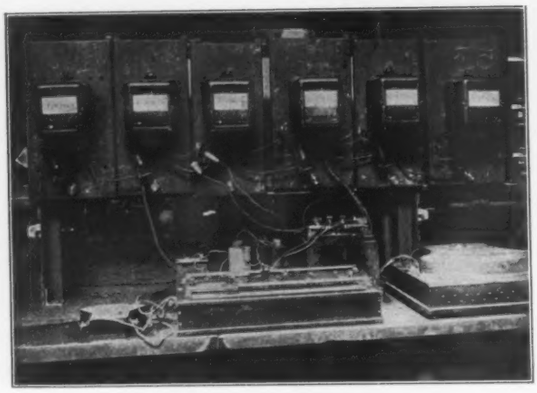

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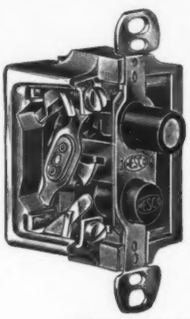

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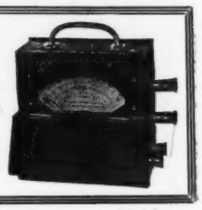

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Supports allow space back of switch for wires.
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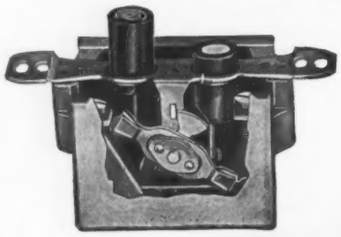
shows the meaning of "Connecticut Quality" in

Flush Switches and Switch Boxes



Simple, strong construction. Instant make and break assured by lock on moving member which holds it until button is down. No sticking.

Any number of gangs without spacers. Simply take off one side of each "Connecticut" box and build up. Save time and money on every job.

THE CONNECTICUT ELECTRIC MFG. CO.
Main Office and Factory, Bridgeport, Conn.
Chicago, 136 W. Lake Street.
Paris, France, No. 7, Rue des Messageries.
New York, 50 Church Street.
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8153

Reasons Why You Should Buy "Union" Fuses

They Are

Accurate in Rating
Correct in Design
Rugged in Construction
Reliable on Short-Circuit
Approved by the Underwriters
Carried by Leading Jobbers

The Knife-Blade type can be reloaded at the Factory at an average saving of 63% of the cost of new fuses.

Catalog No. 26

Chicago Fuse Mfg. Co.

Chicago New York

SAFETY FIRST, LAST AND ALL THE TIME

The Ideal Fuse Strip

Can be used in Daum "Refillable" Fuses to give maximum protection at minimum cost

Example:—Here is shown a 100 ampere renewable fuse. If you want 85 amperes, you cut to first line (marked 85). If you want 75 amperes, you cut to second line (marked 75), etc. You can't go wrong because these fuse strips are made to fit only in different sizes of **DAUM** fuse shells. The capacity is marked on all fuses on inner end of fuse roll. You are never "up against it" with these fuses. You have "Safety First" and you can make your fuses anything under the safety limits. Can also supply fuses in rolls up to 600 amperes. **Prices on request.**

A. F. Daum Company

Sole Manufacturers PITTSBURGH, PA.

FOR AUTOMATIC MOTOR STARTERS, LIFTING MAGNETS, CONTROLLERS, ETC.

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THE ELECTRIC CONTROLLER & MFG. CO.
CLEVELAND, O.

Accurate, Compact, Inexpensive

VOLTMETERS, AMMETERS and VOLT-AMMETERS
Send for complete catalog

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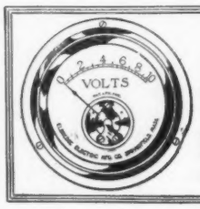
73 Cortlandt Street New York

NAME PLATES

METER AND CLOCK DIALS

Premier Metal Etching Co.
617-625 EAST 18TH ST., NEW YORK.



Pocket Voltmeters, Ammeters, Volt-Ammeters

Lamp Testers, Miniature Switchboard Instruments.

Eldredge Electric Mfg. Co.
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Design No. 1771-C Patented. Equipped with Holophane glass Unit No. 08200 for Nitrogen-Filled Lamps.

Union Metal Lamp Standards

Are strongest where all other standards are weakest.
They are the "SAFETY FIRST" Standards.
The shafts are made of pressed steel reinforced with a steel tie rod construction.
All parts are interchangeable.
There is a Union Metal Lamp Standard for every service.
Send for drawings and photos of our handsome new designs for Type C Mazda Lamps (Nitrogen-filled).

The Union Metal Manufacturing Co.
CANTON, OHIO
Canadian Union Metal, Ltd., Galt, Ont., Canada

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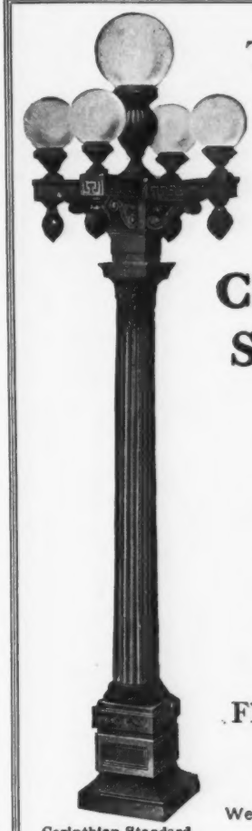

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The Standards of Old Corinth

have stood for centuries and are world-famous for their beauty. Our

CORINTHIAN STANDARDS

are designed and manufactured with this wonderful precedent in mind. We have produced Standards that will illuminate by night and decorate by day—that will maintain the dignity of your city best. Write

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WHITE WAY POLES

MANY DESIGNS AND PRICES RIGHT

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You Can Save Current With

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So designed as to reduce number and candle power of lamps, yet give a bright, sharp sign.

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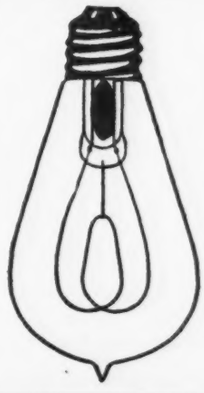

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Consolidated Electric Lamp Company
Tapleyville Station, Danvers, Mass.

PLAIN AND ORNAMENTAL LIGHTING POLES
Of Every Description
Catalog "W" Mailed on request.
Electric Railway Equipment Company
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See our large "ad" in last issue of the "World"

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The Benjamin Plug Current Tap
"A Socket For You That Works Like Two"
Benjamin Electric Mfg. Co.
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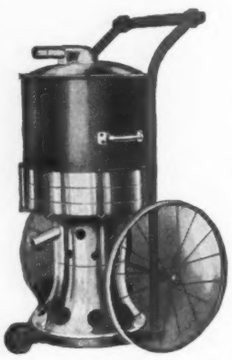
INCANDESCENT BULBS, TUBING & CANE
Write for Prices. The Lippincott Glass Co., Alexandria, Ind.

"Invincible"

Electric Vacuum Cleaners

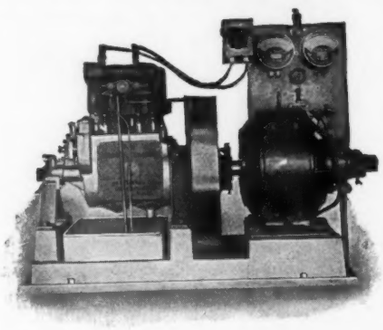
Portable—Stationary

YOU know there is a great demand for electric vacuum cleaners. Why not handle the best—the "Invincible." Highly efficient, extremely simple, rugged and "fool-proof." Motor bearings only wearing parts. Scientific design and 24 carat construction. On the market for over seven years. Every "Invincible" sold helps sell another. With the "Invincible" Line you can sell to every real prospect, because we make every type of machine, from the "Invincible" Baby to the largest "Invincible" Stationary Machine. Twenty-one sizes — all prices from $32.50 up. Write for "Invincible" literature and distributor's prices.



Invincible Mfg Co.
406 Amberson Ave.
PITTSBURGH, PA.

To the Electrical Dealer



You can add materially to your income by taking up the sale in your vicinity of

Brush Electric Lighting Sets

The field for small electric lighting plants is widening all the time. The Brush Electric Lighting Set is complete, compact, absolutely reliable: is made in sizes Two, Four and Ten Kilowatts.

Send for catalogue and trade prices.

The Chas. A. Strelinger Co.
Box W-2 **Detroit, Mich., U. S. A.**
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Let the Shelton Line Help Build Your Day Load

Shelton Specialties prove that current and convenience go hand in hand — you can easily place them all over town.

The Shelton Line includes current-using luxuries, necessities and conveniences of proven popularity. Make them part of your current-selling equipment, and

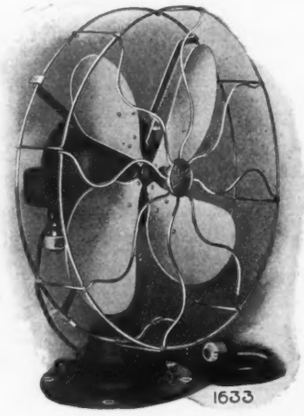
CASH IN

on our advertising campaign in newspapers, magazines and class publications. Write today for catalog and details of our proposition.

Shelton Electric Co. New York Chicago Boston 3

Emerson Fans

"For Service"



The fan with the 5-year factory guarantee.
Desk and Oscillating Fans for A. C. and D. C., complete with plug and cord, ready to run.

Induction Ceiling Fans.
Prompt Shipments Now.

The Emerson Electric Mfg. Co.
2032 Washington Ave., St. Louis, Mo., or 50 Church Street, New York City

C & C MOTORS

THE liberal use of copper, large number of ventilating ducts and adequate heat radiating surface insure high overload capacity.

The C & C design permits of a speed range of 7:1 by field control, making these motors especially suitable for direct connection to machine tools.

The motors are adapted to slow speed work, such as direct connection to blowers, and have been for many years the standard specified motors for ventilating systems. They are designed in both the horizontal and vertical types for floor, wall or ceiling use. Built in sizes from 3 to 125 horsepower. Write for Bulletin E.

C & C Electric & Mfg. Co.

Main Office and Works:

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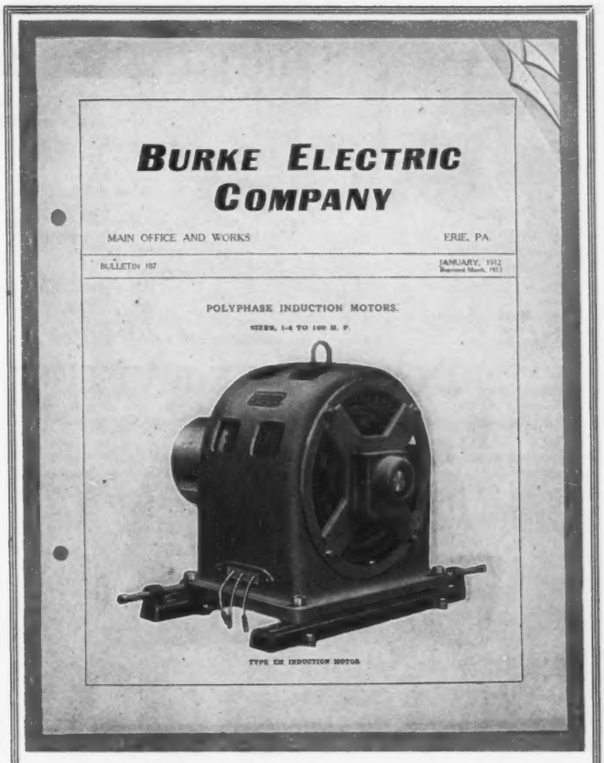
New York Philadelphia Boston Chicago

Representatives in all Principal Cities 45

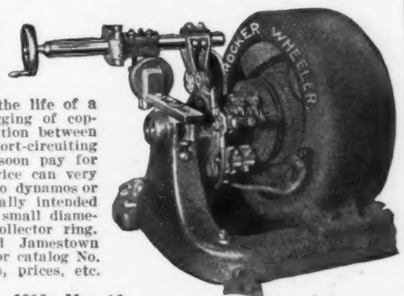


"THIS BULLETIN 107-A is free on your request. You will be a better posted electrical man if you get it and read it."

BURKE ELECTRIC CO., Principal Office & Works ERIE, PA. 1

JORDAN COMMUTATOR TRUING DEVICE

This device will true your commutator without removing the armature; easy to attach and operate. Does not take large cuts, which shorten the life of a commutator; no dragging of copper across the insulation between the bars, thereby short-circuiting the same, and will soon pay for itself. This type device can very readily be attached to dynamos or motors and is especially intended for machines having small diameter commutator or collector ring. Silver Medal Award Jamestown Exposition. Write for catalog No. 3, with list of users, prices, etc.



Patented April 26, 1898; May 16, 1905; Sept. 6, 1910, and Jan. 24, 1911. Other patents pending.

Front View of Type J Commutator Truing Device attached to Crocker-Wheeler Motor.

JORDAN BROTHERS, Inc., 74 Beekman Street, N. Y. City

High-Grade Carbon Brushes

The heads of a thousand dynamo rooms state positively over official signatures that LE VALLEY VITAE CARBON BRUSHES

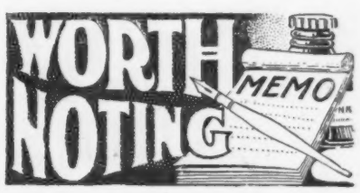
Actually save their first cost again and again;
Save time, labor and annoyance;
Save commutators, keeping them unscratched and glossy;
Save shut-down losses and repair bills;
Save and make reputations for men and machinery;

Are in fact the one absolutely proven, generally admitted high-grade Carbon Brush, worthy of complete dependence and exclusive use in all places under all circumstances.

Le Valley Vitae Carbon Brush Co.

4123 Park Avenue, New York City

Catalogs and Testimonials on Application



No brush has ever excelled the service records of Le Carbone Brushes. They possess a record for efficiency and economy that at least merits a trial.

W. J. Jeandron

173 Fulton St., New York

1

You can figure on Edison Batteries for your next installation for House Lighting, if you will write for the electrical data on Edison Cells and our bulletin 1031.

Study the Edison Battery Construction

The elements and features of the Edison Storage Battery are distinctive and were developed by a master mind.

SERVICE ADVANTAGES.

No plate renewals.
Not injured by overcharging.
Not injured by complete discharging.
Not injured by short circuiting.
Can charge before completely discharged.
Can charge at normal or high rates.
No Hydrometer necessary.
No internal cleaning.
No "buckling" of plates.
No Sulphation.
No deterioration from standing.
No expert attention required.
No injurious gases or fumes.

CONSTRUCTION ADVANTAGES.

Cells shipped charged.
Steel Cell Containers.
Cells assembled in trays.
Negative active material in Steel pocket.
Positive active material in Steel tubes.
Alkaline Solution—No Acid.
No sand trays.
Quick detachable cell connectors.
Iron Oxide in negative plate.
Nickel Hydroxide in positive plate.
Light weight.
Portable trays.
Electric water filling outfit.

EDISON STORAGE BATTERY CO., 145 Lakeside Ave., Orange, N. J.

BALL AND ROLLER BEARINGS

NORMA

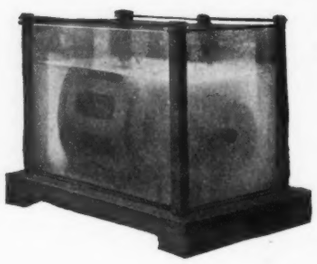
The Norma Company of America

1790 Broadway New York

LINCOLN MOTORS ARE

impregnated with our special Oil and Waterproof Varnish, will

OPERATE UNDER WATER



Such insulation will eliminate many of your motor troubles.

Lincoln Electric Company

Kelley Ave. & 38th St., Cleveland, O.

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Central National Bank Bldg. ST. LOUIS, MO.
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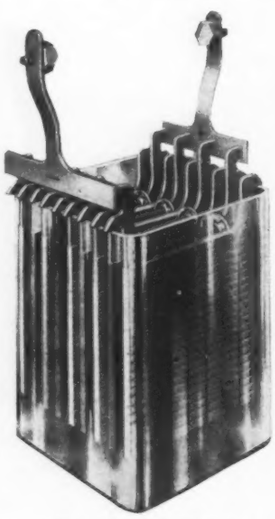
1205 Electric Bldg., Buffalo, N. Y.

PETSCHEL
Home-Lighting Battery



Petschel Type 9D Cell

A storage battery furnishing approximately 50 per cent more ampere hours per unit of weight and size than any other battery made. A battery with longer life and better maintenance of voltage under heavy current discharge than can be guaranteed by other battery manufacturers. These advantages are due to our improved method of introducing the paste into the plates and forming it in them. Petschel batteries have many other features worthy of your attention and they cost no more than other batteries. Ask for Catalog A and Bulletin 21.

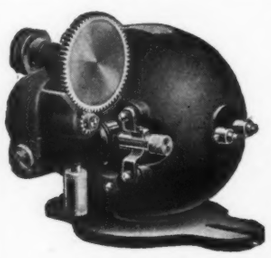
Petschel Storage Battery Co., Inc.

3051 W. Lake Street, Chicago

When the worm turns

inside of a gear filled with the proper grease as it does in the

Eck Worm-Geared Motors



you get silent, efficient operation and an ideal machine for very slow speeds—just the thing for office accessories, such as adding machines, duplicators, etc., or advertising novelties such as working models, rotating display shelves, etc. 1/32 to 1/6 H.P. The subject is covered in the Eck Book Bulletin No. 44.

ECK DYNAMO & MOTOR CO.

BELLEVILLE, N. J. 1

For

GENERATING SETS

ENGBERG'S

ELECTRIC & MECHANICAL WORKS

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THE PARAGON GROUND CONE

is the choice of the discriminating buyer. No "just as good" will do for him. Paragon construction is different and better. Just a hollow perforated copper cone installed in a post hole. Try them. Economical, no upkeep cost. Write for booklet.

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Useful Information on Storage Battery Locomotives

We have just published a new 20-page technical bulletin on the subject of storage battery locomotives. It is not merely a description of our apparatus but contains much valuable data as well as methods of determining the proper size of battery for storage battery locomotives in any given service.

It also gives information on the "Ironclad-Exide" Battery, which has shown such satisfactory results in storage battery locomotive service.

A copy of this bulletin can be secured on request to our nearest sales office.

THE ELECTRIC STORAGE BATTERY CO.

New York Boston Chicago PHILADELPHIA, PA. Denver Portland, Ore. San Francisco
St. Louis Cleveland Atlanta Rochester 1888-1914 Seattle Detroit Los Angeles Toronto

Acme 60-61-62-64

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NUNGESSER Carbon Brushes

Are giving excellent service on Ry. motors, Rotaries and big generators.

The Nungesser Carbon & Battery Co.
CLEVELAND, OHIO

SPARKING

reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire. All of this may be avoided if you use

The only article that will prevent sparking. Will keep the commutator in good condition and prevent cutting. Absolutely will not gum the brushes.

It will put that high gloss on the commutator you have so long sought after

Send for Stick 50c PER STICK $5.00 PER DOZ.

For Sale by all Supply Houses, or **K. McLennan & Co.** Sole Manufacturers
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BEST MANUFACTURING CO.

PITTSBURGH, PA.

Manufacture and Erect

Piping Systems for Central Stations

TRUMP TURBINES

All styles and designs built to suit your location. Send at once for our illustrated catalog.

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Special
Blanking, Trimming, Piercing & Forming
DIE WORK
Solicited
The Columbus Die, Tool & Machine Company
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COMMUTATOR INSURANCE

THAT'S WHAT WE OFFER, FOR THERE'S NO FRICTION OR WEAR WITH THESE FIBRE GRAPHITE BRUSHES.
BEING 60 PER CENT. PURE GRAPHITE INSURED LOW RESISTANCE, NO SPARKING UNDER VARYING LOAD. LONGER WEAR AND NO GREASING.

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WILLARD STORAGE BATTERIES

FOR ALL PURPOSES
Manufactured by
The Willard Storage Battery Co.
Cleveland, Ohio

Remote Control, Reliability

and many other reasons account for the popularity of

Century

SINGLE PHASE MOTORS

among the manufacturers of Pumps, Air Compressors, Vacuum Cleaners, Organ Blowers, etc.

¼ to 40 H.P.
25 to 140 Cycles

Bulletin No. 121 goes into detail.

Century Electric Company

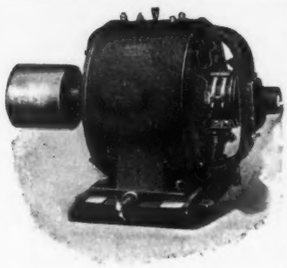
19th, Olive to Pine Sts.
St. Louis, Mo.

New York Office
30 Church St.

113

TRIUMPH

Only the *Best* goes into



Triumph D. C. Motors

That accounts for the fact that we buy the most expensive carbons on the market, because every item of construction in Triumph D. C. Motors must grade up to one standard —the best that money, brains and workmanship can produce. The result is a motor unsurpassed in efficiency and ruggedness which comes to the user with definite guarantees of performance.

Bulletin 491 containing information of value will be sent on request.

The Triumph Electric Company
CINCINNATI, O.
Branches in Principal Cities

When Reactance Voltage Is High

and other influences prevent good commutation, use

MORGANITE BRUSHES

and stop the trouble. They have low contact-resistance on the edge where current enters, and high contact-resistance on the edge where it leaves, thus facilitating sparkless collection of current.

If you have brush troubles, send us data on your machine, and we will send you sample Morganite Brushes.

THE MORGAN CRUCIBLE CO., LTD.
114 Liberty Street, New York City
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Lewis-Roth Co., Denckla Bldg., Philadelphia, Pa. 1

BRYANT - BERY
Commutator Truer

Will true your commutator without removing the armature or without stopping the delivery of power. It grinds down the mica and copper alike, without tearing or breaking the insulation, or dragging the copper, making slotting unnecessary. It is adaptable to all sizes of commutators. We also manufacture small steam turbines.

Write for descriptive matter.

Bryant - Bery Steam Turbine Co.
Detroit, Mich.

THE AUTOMATIC

is so inherently good, so high class, so satisfactory to the people and sells at such a medium price as to fulfill every requirement in a popular electric washing machine. We have a 32 page book, a beautiful thing in colors, which gives the whole story. **This book is called Bulletin 77.** Ask for it and we will be glad to send it to you. It is worth having. It gives reliable information about washing machines. When you have read it you will know why the AUTOMATIC is popular among those who "Do it electrically." It not only adds to the "off-peak" load, but makes friends for the plant. Get in touch with us. We can do you some good. Remember, Bulletin 77 is what you want.

Automatic Electric Washer Co., Inc., Newton, Iowa

Member of Society for Electrical Development
Do it Electrically. 3

Reliance Adjustable Speed Motors

Run at any speed over any range up to 1 to 10.

No electric controller used.

Reliance Electric & Engineering Co.
1046 Ivanhoe Road, Cleveland, Ohio

DIXON'S GRAPHITE BRUSHES

Keep Commutators In Perfect Condition
"Graphite Brushes," Booklet 47

JOSEPH DIXON CRUCIBLE COMPANY
Jersey City New Jersey 2

Is Your Material HEAVY? This Portable Drill Is LIGHT

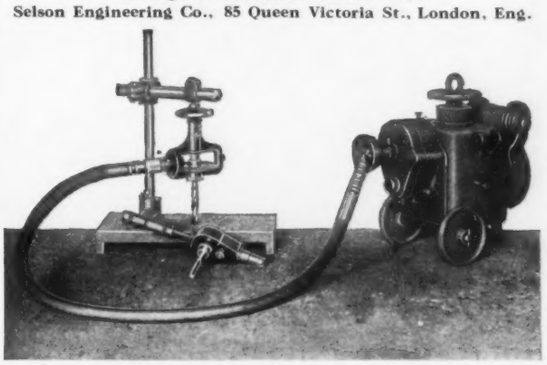
Take the tool to the work

instead of taking the work to the tool.
It's a perfected combination of Stow Flexible Shaft and Inclosed Multi-Speed Motor, which gives

The Exact Speed Required

for any drilling, tapping or reaming operation within the capacity of the tool.
Rheostat and starting box are eliminated—an absolutely unbroken range of speeds is secured by a turn of the hand wheel.
A reel with 60 feet of insulated wire enables you to work at a distance from the nearest source of power.
This outfit is fully described on p. 47 of our Catalog No. 13—write for your copy.

Stow Manufacturing Co.
Binghamton, N. Y.
Chicago Office, 106 S. Jefferson St.
Selson Engineering Co., 85 Queen Victoria St., London, Eng.

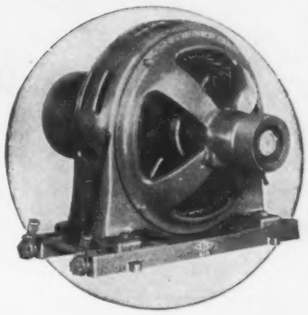


4

ELECTRIC MACHINERY CO

MINNEAPOLIS EM MINNESOTA

For the Small Plant Too



we have alternators which give just as dependable service as our big machines delivering thousands of Kilowatts.

The type shown here is built in sizes from 10 K.W. up to 200 K.W., and is belt-driven for power and lighting service in small Central Stations and industrial plants.

Tell us details regarding service and capacity required, and we will quote on a size and type of machine that will save money for you.

Ask for Bulletins Describing Our Entire Line

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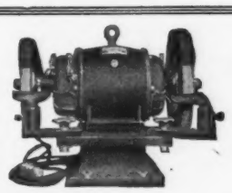
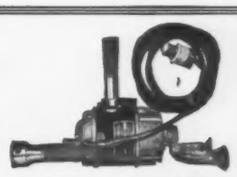


Every Machine Shop and Garage Is a Profitable Prospect

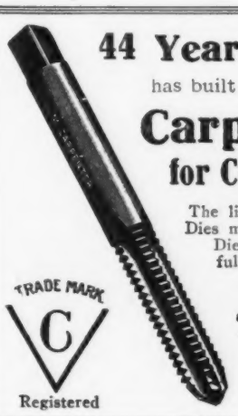
for the Central Station man who will put a little time into selling

U. S. ELECTRIC DRILLS AND GRINDERS



Drills for drilling metal, in sizes from ¼" to 1¼".
Centre Grinders for treeing lathe centres, sharpening cutters and dies or for general grinding on lathe, shaper or planer.
Bench Grinders for tool sharpening or general grinding or polishing. Made in six sizes, from ¼ H.P. to 5 H.P.
The first move toward "starting something" is to write for detailed information and prices. Do it now.

The United States Electrical Tool Co. Cincinnati, Ohio
New York Office, 50 Church St. Chicago Office, 8 E. Michigan St.
Boston Office, 12 Pearl St. St. Louis Office, Victoria Bldg.



TRADE MARK C Registered

44 Years of Supremacy

has built an enviable reputation for

Carpenter's Tools for Cutting Screw Threads

The line includes Machine Screw Taps and Dies made to A. S. M. E. Standard, Taps, Dies, Die Stocks and Tap Wrenches—all fully described in the Carpenter Catalog

Write for your copy to-day.

The J. M. Carpenter Tap and Die Co.
Pawtucket, R. I.

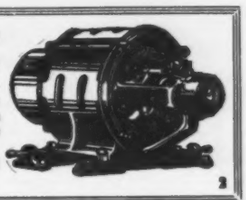
5

NORTHERN CRANES

Northern Engineering Works Detroit, Mich.

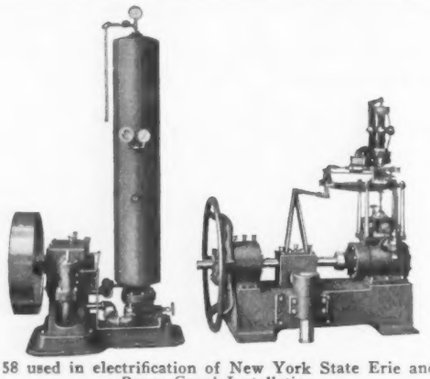
The "Keep-A-Running" Qualities of Richmond Polyphase Motors

make them the very best alternating-current motors on the market to-day. Bulletin No. 14 goes into detail—write for a copy.



Richmond Electric Works
Richmond, Virginia

3



58 used in electrification of New York State Erie and Barge Canal Installation.

YOU ARE LOOKING for the one water wheel governor which is better adapted to your requirements than any other. We have it. We build about forty different designs of governors. They are used in the largest water wheel installations in the world and in thousands of smaller ones.

WE ARE LOOKING for an opportunity to get in touch with you. May we have it?

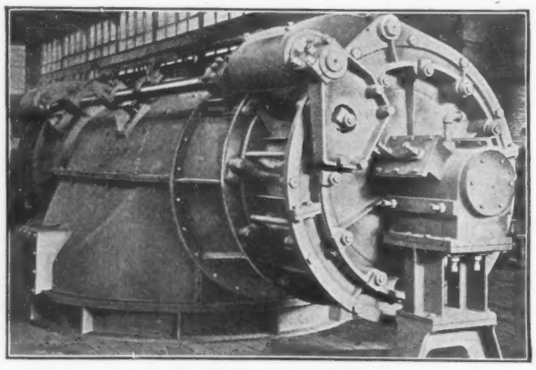
We will be glad to put you on our permanent mailing list

The Lombard Governor Co.

Works and Main Office, Ashland, Mass.

Branch—504 Candler Bldg., Atlanta.

West Coast Agents—Pierson, Roeding & Co., 118 New Montgomery St., San Francisco; 707 Spalding Bldg., Portland, Ore.; 523 Colman Bldg., Seattle, Wash.



Samson Hydraulic Turbines

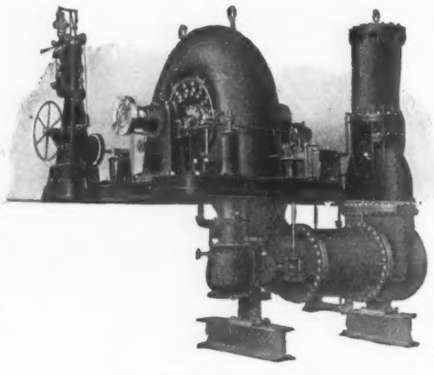
3,000 Horse Power

This illustrates one of two units installed for the Virginia Passenger & Power Co., Richmond, Va. Each unit consists of SAMSON horizontal shaft turbines direct connected to generator. Head of water 25 feet, total capacity 3000 H. P. We would like the opportunity of bidding on your requirements in the way of turbines, as we are fully prepared to furnish the latest and best design of turbine work. Shall we send you a catalog?

JAMES LEFFEL & CO.

308 Lagonda Street, Springfield, Ohio, U. S. A.

3



Hydraulic Turbines

ENGRAVING REPRESENTS

One of Three Units

Each

1700 Horse Power, 720 R. P. M., 280 Ft. Head

Turbines designed to meet all requirements for heads from 5 to 600 feet

WRITE FOR BULLETIN W

S. MORGAN SMITH CO., York, Pa.

BRANCH OFFICES: 1

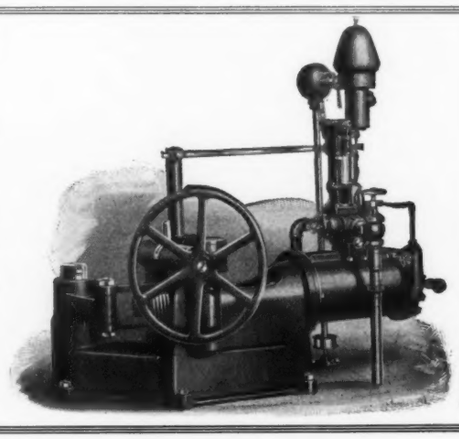
176 Federal Street, Boston, Mass. 644 American Trust Building, Chicago, Ill.

BUILT TO FIT THE JOB!

This is One of the More Recent Designs of

WOODWARD Oil Pressure Waterwheel Governors

built to fit the job. A large number of recent hydro-electric installations have the water wheel and generator on one vertical shaft and this style of governor is built to operate directly on the vertical gate shaft. The base of the governor is extended and forms an upper bearing for the gate shaft, making the most rigid arrangement that could be devised. The hand wheel device is original and much more efficient and convenient than a screw and split nut on the piston rod. The governor, as well as the pump may be built with vertical driving shaft, so as to belt directly from the wheel shaft. These governors occupy the minimum of floor space, and every working part is accessible without disturbing other parts. Other special features are described in our printed matter, which will be mailed upon request.



WOODWARD GOVERNOR CO. 1

202 Mill Street ROCKFORD, ILLS.

Link-Belt Silent Chain

For the Efficient Transmission of Power

Flexible as a Belt—Positive as a Gear—More Efficient than either

FAN DRIVE

Full particulars, price lists and method of figuring silent chain drives shown in Data Book 125, sent on request.

LINK-BELT COMPANY

PHILADELPHIA CHICAGO INDIANAPOLIS

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Real Flexibility

in connecting the shafts of any two close coupled machines eliminates the expense of extremely careful alignment, and provides for the misalignment which causes trouble and expense when rigid couplings are used.

FRANCKE FLEXIBLE COUPLINGS

are absolutely flexible in three directions. They take the same space as a rigid coupling, require less time to disconnect, and, being all metal, the service and durability are guaranteed. Built in all capacities from ⅛ H.P. to 10,000 H.P. Send for descriptive literature.

SMITH-SERRELL CO., Inc.

General Sales Agent for THE FRANCKE CO.

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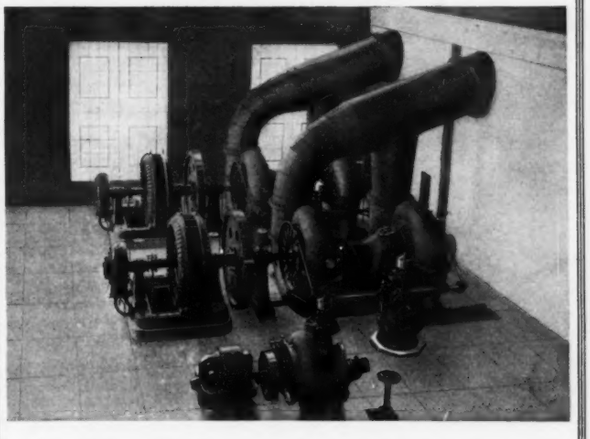

Pelton-Francis Turbines

operating under low heads have excellent regulation. A typical installation is shown above, that of the Consumers Light and Power Company, Cannon Falls, Minnesota. These turbines work under a head of 48 feet, the generators carrying a mixed load subject to wide fluctuations.

We shall be pleased to send you a complete description of this plant.

The Pelton Water Wheel Co.

91 West St. New York, N. Y.

2231 Harrison St. San Francisco, Cal.

1

You Don't Need To "Kill" the Circuit

to quench an arc. Make that your last resort. Remember that

Pyrene

Quenches Any Arc

Your first move should be a reach for the handy Pyrene Extinguisher. One "shot" at the right spot, and the arc is out—perhaps a machine is saved. Put Pyrene in every station, on the emergency wagon, in the man-holes. Thousands of Pyrene Fire Extinguishers are installed on the premises of hundreds of Central Stations. Get data especially prepared for you electrical men.

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7578

Atlas Diesel Engines

VERTICAL, FOUR-CYCLE

300 to 1,000 H. P. Units

The Diesel cycle without modifications—enclosed in a simple, massive structure—designed for continuous service—as durable and dependable as the best steam plant. Sold on the merits demonstrated in actual service.

Highest efficiency, close regulation and successful parallel operation positively guaranteed.

Write us for Bulletin No. 201-A.

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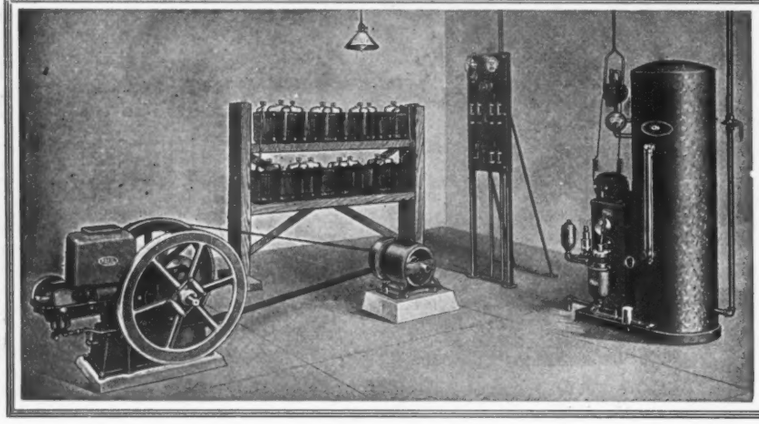

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SYSTEMS
WATER
LIGHT
POWER

Catalog 2502, our latest book, illustrating and listing 144 different systems, will be sent to interested dealers upon request.

Fort Wayne Engineering & Mfg. Co.
Main Office and Factory
Fort Wayne, Indiana, U. S. A.

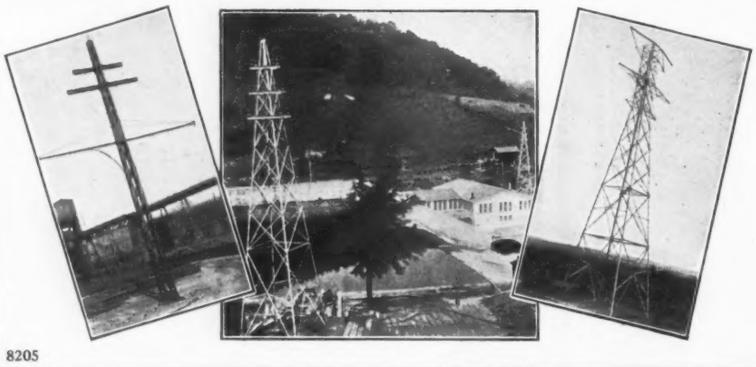

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Plate and Structural Steel

of Every Description
Designed, Fabricated, Erected

Galvanized Transmission Towers, Structural Steel Buildings, Penstocks, Gas Plants, etc.

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Pittsburgh, Pa.

DEARBORN TREATMENT

enables you to get *more power* at *lower cost.*

Prevents scale formation—saves fuel. Prevents corrosion and pitting—reduces repair bills—avoids shutdowns for repairs—keeps boilers in condition to yield their full quota of power constantly.

Prepared to suit conditions shown by analysis of the water. Gallon sample required.

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THE BABCOCK & WILCOX COMPANY

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WATER TUBE BOILERS
Steam Superheaters **Mechanical Stokers**

BRANCHES
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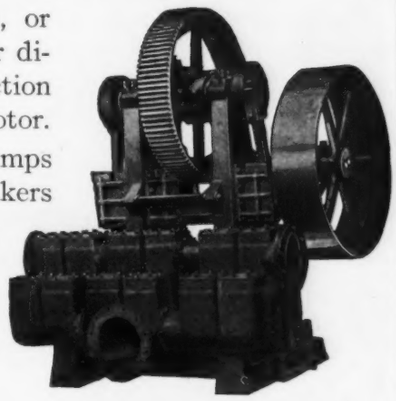
Deane of Holyoke Power Pumps

Belt driven, or arranged for direct connection to electric motor.



Deane pumps are pacemakers in strength, durability, compactness and accessibility.

No matter what your pumping need may be we have a pump to suit the conditions.

But *whatever* its purpose you can be certain of this; that into *every* Deane pump is built the high standard of quality that has made the Deane line famous.

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The Deane Steam Pump Co.

Works: Holyoke, Mass. **New York Office: 115 Broadway**

Branch Offices in All Principal Cities. D-281.2

Make Ice A *Real* By-Product

Instead of a 48- to 60-hour freezing time, you can turn out perfect ice in 12 hours with the

Parsons "Quick-Freeze" System

This leaves the whole capacity of your plant free to handle peaks, yet enables you to use your surplus power profitably during "off-peak" hours.

The Parsons "Quick-Freeze" System is adapted alike to compression and absorption plants, and vastly improves the efficiency of either.

Ask for full particulars.

United Ice Improvement Co.

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Cool Comfort and Cold Cash

Twentieth century people *demand* ice. And the price is going up.

CARBONDALE ICE MACHINERY

opens to Central Stations a golden opportunity to make some extra profit in the ice business. Three H. P. of exhaust steam makes 1 ton of ice. Convert your exhaust into cash. Write for details.

Carbondale Machine Company

Carbondale, Pa. 7540

MOVING GRATES

Send for Booklet W

THE RILEY

Self-Dumping Underfeed

STOKER

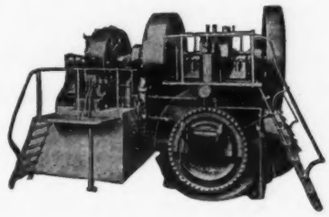
is the only underfeed stoker that can break up clinker as fast as it forms.

SANFORD RILEY STOKER CO., LTD.

Worcester, Mass.

51-4

Write for the Operating Figures on Buckeye-mobile



If you are considering a new generating station or additional power.

We guarantee to deliver power for about 2 lbs. coal per k. w. hour at switchboard, including auxiliaries.

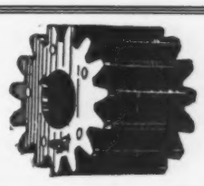
New Bulletin 111 B

BUCKEYE ENGINE CO., Salem, Ohio

35

Noiseless Pinions

for motor and other high speed drives, see our large advertisement in first and third issues of the month.



New Process Gear Corporation

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FOR MOTORS REDUCE THE COST OF UP-KEEP

THE HESS-BRIGHT MANUFACTURING COMPANY

Front Street & Erie Avenue **Philadelphia, Pa.**

We Finance
Extensions and Improvements

to Electric Light, Power and Street Railway properties which have established earnings. If prevented from improving or extending your plant because no more bonds can be issued or sold, or for any other reason, correspond with us.

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Paid-up Capital and Surplus, $12,500,000

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Dealers in Proven Electric Light, Power and Street Railway Bonds and Stocks.

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DIESEL OIL ENGINES

—and—

Steam Engines

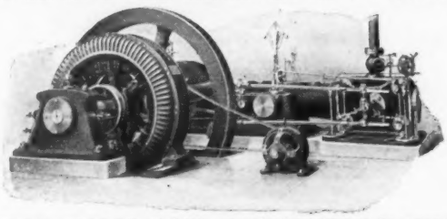
Auburn, New York

Sole American Licensees
SWEDISH DIESEL ENGINE CO.

New York Office 50 Church Street

What You Have Been Waiting For

50, 75 and 100 K. V. A. Generator and 150 R. P. M. Engine

1870  1914

An engine running at high speed that is really economical. A true Corliss Engine with 4 valves and releasing gear. A governor that actually governs. An engine type A.C. Generator in the smaller sizes. Everything of the latest design. Engine on exhibition in the Bourse, Philadelphia.

Murray Iron Works Co., Inc. Feb. 1, 1870 **Burlington, Ia.**

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COAL & IRON NATIONAL BANK

143 Liberty Street
New York

CAPITAL	SURPLUS & PROFITS (EARNED)
$1,000,000.00	$564,762.27

Save the Heat

in your Exhaust Steam by use of

"MICHIGAN" Steam Pipe Casings

for Insulating Underground Steam Heating Pipe,

and turn it into revenue instead of letting it go to waste. Big Central Stations all over the country are doing this, and find Michigan Pipe Casings indispensable. Michigan Pipe Casing is absolutely waterproof —it is tin-lined to prevent radiation and is built of the most effective non-conducting materials. *A word from you will bring particulars and prices—write!*

The Michigan Pipe Co.

Bay City, Mich.

Also Manufacturers of MICHIGAN Combination Steel and Wood Water Pipe for Conveying Water in Connection with Hydroelectric Plants.

Green Chain Grate Stokers

For Water Tube and Tubular Boilers

GREEN ENGINEERING CO.

1330 Steger Bldg. CHICAGO, ILL.

Catalogue "G"—Green Chain Grate Stoker.
Catalogue No. 8—GECO Pneumatic Ash Handling Systems sent on application.

Try World "Positions Wanted" columns for high grade assistants.

Try World "Positions Vacant" columns for high grade positions.

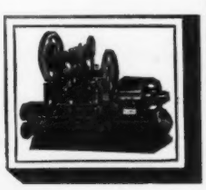
Get your Wants into the Searchlight

The

Deming

Single Acting Triplex Plunger

PUMP



Motor driven, geared or belted.
Is a ready means for advancing the sale of Central Station energy.

All parts are well made, to wear long in use. The pump is economical of floor space and requires little attention during operation. For the house or the factory. All sizes, lifts and capacities. Write for prices.

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Hand and Power Pumps for All Uses

HENION & HUBBELL	Chicago
HARRIS PUMP & SUPPLY CO.,	Pittsburg
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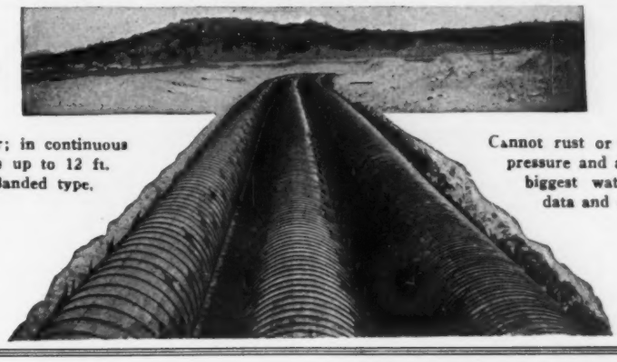
ROOT, NEAL & CO.	Buffalo

PORTLAND WOOD PIPE FOR PUMPING PURPOSES

Equal to Cast Iron **Better Than Steel**



Made of Oregon or Douglas Fir; in continuous Stave Pipe, in all practical sizes up to 12 ft. inside diameter. In Machine Banded type, 2-in. to 24-in.

Cannot rust or become incrusted. Stands high pressure and any temperature. Used in world's biggest water-works. Write for complete data and our unusually low prices.

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Portland, Ore.

3

Here's a Chance For Greater Profits

We want busy, live electrical supply dealers right now in many states, to handle our

"Universal Lighting System"

You know how the demand for small electric lighting plants is steadily growing and how inviting are the profits. Here's your chance to "cash in" on this paying proposition with no interruption to regular business.

We are looking for hustling, up-to-date dealers to represent us. To the right men, we will give

Exclusive Territories

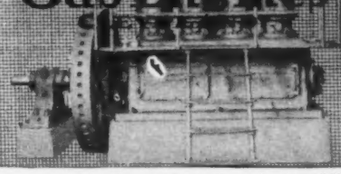
and attractive propositions.

Write us at once for full interesting particulars.

Universal Battery Co.

3410-24 La Salle St., Chicago.

Bruce-Macbeth Gas Engines



If others—many others whose word you rely on—have saved 50 to 75% in power costs, WHY CAN'T YOU? Write for the evidence.

The Bruce-Macbeth Engine Co

3122 Euclid Ave. N.W.

CLEVELAND

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Chicago Rawhide Mallets

save battered-up machine parts in any shop where assembling or repairs are done.

Rawhide being a non-conductor of electricity, these mallets are especially adapted to electrical work.

Write for quantity prices.

The Chicago Rawhide Mfg. Co.

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INTER-POLE MOTORS

For all electric drives. Constant or adjustable speed. Freedom from sparking. It's due to the INTER-POLES

Bulletins mailed on request

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MARIS BROS

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WATER WHEEL GOVERNORS

Reliable—on the job—every day and minute—because made right. Close regulation for wheels of every make and size—any kind of load—any head. Fully guaranteed.

GOVERNOR DEPARTMENT Troy

LUDLOW VALVE MANUFACTURING CO., New York

VALVES and FITTINGS

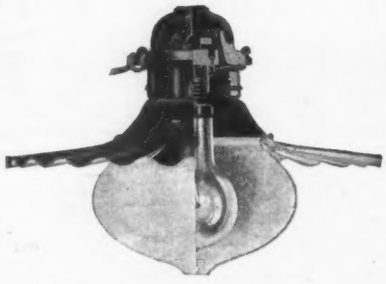
All Sizes for all Purposes

Complete Piping Systems

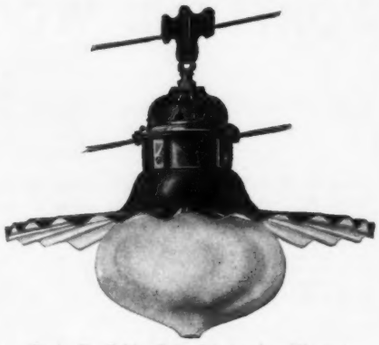
Pittsburgh Valve, Foundry & Construction Co.

Pittsburgh, Pa.

Cutter "Majestic," "Spartan Straight Arm" and "Imperial" Brackets.



Cutter One Piece Fluted Street Hood, Body with 24-inch Radial Bowl, Reflector and Alba Diffusing Globe.



Style F, Cable Grip Suspension Fixture.

The New Cutter Streethoods Meet All Street Lighting Requirements

Reflectors in one-piece and two-piece styles, designed to secure high efficiency in useful downward lighting are adaptable to all sizes and types of incandescent lamps.

Cutter Brackets are artistic in appearance, durable in construction and easy to install.

Bulletin AA3196 will help you solve your lighting problems. Write for a copy. You will find just the fixture for your requirements.

GEORGE CUTTER COMPANY

Main Office and Factory
403 Notre Dame St., So. Bend, Ind.

Eastern Office
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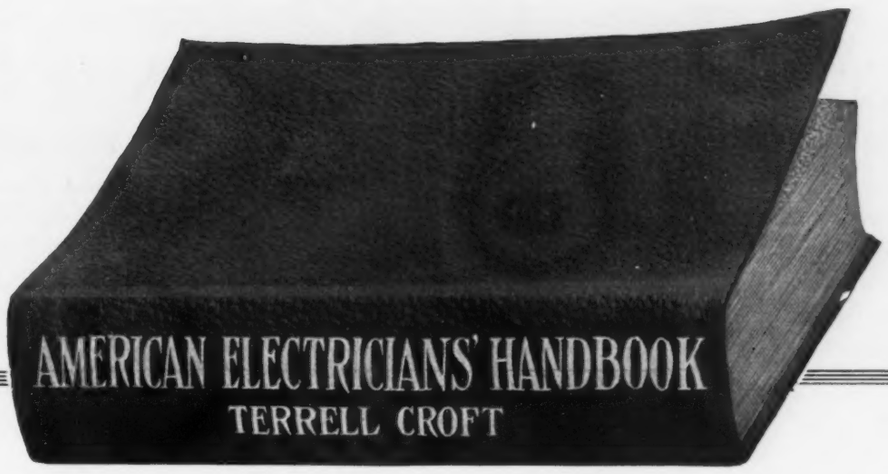

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1 50	Westingh'se 3-phase, 1100-2200-volt	900
1 75	Triumph 3-phase, 60-cycle, 240-volt	900
1 100	Gen. Elec. ATB., form P, 240-volt, 3-phase, 60-cycle	900
1 105	Ft. Wayne, 3-phase, 60 cycle. 240-volt, direct connected to Ames engine	257
1 120	Elec. Mach. Co., 3-phase, 60-cycle, 2200 volt	600
1 120	Gen. Elec. type AS.	900
1 120	Westinghouse, 3-phase, 1100 or 2200-volt	720
1 150	Ft. Wayne, WAL.,	450
1 300	Gen. Elec., ATB., 3-phase, revolv. field, 220 or 440 volts speed	600

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K.V.A.		Speed
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1 300	Gen. Elec., ATB., 3-ph., revolv. field, 2300 volts	500

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KW.		Speed
1 18	Crocker-Wheeler	900
1 20	Commercial	1100
1 20	Northern	950
1 22	Ft. Wayne	1200
1 22	Northern	650
1 25	Allis-Chalmers	750
1 30	Elec. Mach. Co.	950
1 35	Gen. Elec., type CL.	900
1 37½	Triumph	1000
1 37½	Westinghouse	400
3 40	Gen. Elec.	575
3 42	Milwaukee	1100
1 42½	Westinghouse	675
1 45	Crocker-Wheeler	700
1 45	Western Elec	550
1 50	Northern	650
1 50	Westinghouse, 6-pole, direct-connected to Westinghoue engine	320
1 50	Northern, MP, direct-connected to All-free hor. center-crank engine	300
1 60	Western Elec.	1050
1 65	Milwaukee	950
1 70	Westinghouse	800
1 70	Gen. Elec., 3-wire generator set, consisting of 2 35 KW. Gen. Elec. form L 125 v. generator, direct-connected to one Shepherd engine	300
1 75	Westinghouse, MP, type M	750
2 75	Westinghouse, MP, comp., engine type.	200
1 75	Westinghouse, 6-pole, direct-connected to Ideal self-oiling auto center-crank engine	250
1 85	Westinghouse	750
1 100	Westinghouse	700
1 100	Gen. Elec.	600
3 100	Westinghouse	550
1 100	Jeffrey	480
1 100	Milwaukee, direct-connected to Buckeye engine	250
1 100	Crocker-Wheeler, direct-connected to Ideal hor. center-crank engine	250
2 150	Western Elec., 6-pole	500
1 150	Westinghouse, MP, 3-wire, 125-250-volt.	580
1 150	Willey, 8-pole direct-con. to 4-valve Atlas engine	225
1 200	Allis-Chalmers, 3-bearing	300
1 240	Crocker-Wheeler, MP, direct-con. to 15 x 28 x 36-in. cross-compound Vilter-Corliss condensing engine	120

110 to 125-Volt D. C. Generators

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1 17	Westinghouse	1125
1 17	Milwaukee, with Westinghouse Junior engine	750
1 17½	Crocker-Wheeler	1400
2 17½	Triumph	1200
2 17½	Roth	1150
2 18	Crocker-Wheeler	875
1 20	Elec. Mach. Co.	825
2 25	Triumph	950
1 25	Western Elec.	800
1 25	Sprague-Lundell	850
2 25	Gen. Elec., Curtis turbine	3600
2 25	Gen. Elec. direct-connected to Westinghouse gas or gasoline engines	350
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1 27½	Ft. Wayne	700
1 28½	Westinghouse	650
1 30	Northern	1000
1 30	Ft. Wayne	750
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1 35	Willey	800
1 40	Sprague-Lundell	725
1 40	Westinghouse	550
1 45	Gen. Elec.	975
1 45	Westinghouse	850
1 47¼	Westinghouse	600
2 50	Triumph	850
1 50	Triumph	615
1 55	Gen. Elec.	875
1 55	Westinghouse	800
1 55	Sprague	625
1 56¼	Westinghouse	800
1 60	Northern	825
1 60	Thompson-Ry	600
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1 65	Gen. Elec.	825
1 70	Ft. Wayne	900
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1 1	Triumph, 220 v.	1140
1 2	Gen. Elec., 110 or 220 v.	1800
1 2	Allis-Chal., 220 v.	1720
1 2	Wagner, 220 v.	1720
2 3	Gen. Elec., 220 v.	1800
2 3	Wagner, 220 v.	1720
4 5	Gen. Elec., 220 v.	1800
1 5	F'b'ks-Morse, 220 v.	1700
1 5	Richmond, 220 v.	1140
1 5	Westinghouse, type F, size 161, slipring, 220 or 440 v.	1120
1 5	Fairbanks-Morse 220 or 440 v.	900
3 5	West. Elec., 220 or 440 v.	900
3 5	Gen. Elec., slip-ring type, variable speed, 220 v.	900
1 7½	Wghse., CCL, 220 v.	1700
3 7½	Gen. Elec., form L, 220 v. (wound rotor)	1200
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1 7½	Gen. Elec., form K, 220 v.	720
1 10	Gen. Elec., form L, (wound rotor), 220 or 440 v.	1800
1 10	Westinghouse, type H (wound rotor), 220 v.	1120
1 10	Fairbanks - Morse, 220 or 440 v.	900
1 10	Gen. Elec., form M, slip-ring, variable speed, 220 v.	900
1 10	Westinghouse, type CCL, 220 v.	850
1 10	Westinghouse, type CCL, 220 v.	580
2 15	Gen. Elec., type C, 220 or 440 v.	1800
1 15	Allis-Chalmers, 220 or 440 v.	1130

H.P.		Speed
2 15	Gen. Elec., form K, 220 or 440 v.	720
1 15	Westinghouse, type CCL, 220 v., back-geared	690-175
3 20	Gen. Elec., form K, 220 v.	1200
2 20	Gen. Elec., form L (wound rotor), 220 or 440 v.	1200
6 20	Westinghouse, type CCL, 220 or 440 v.	1150
2 20	Wagner, type BP, 220 or 440 v.	1140
1 20	Gen. Elec., form L (W'nd rotor), 220 v.	900
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1 25	Gen. Elec., Form "K," 220-440 v.	900
6 25	West. Elec., Form "CS," 220-440 v.	850
1 25	Gen. Elec., Form "K," 220 v.	720
13 30	West'gh, "CX," 220-440 v.	1120
4 30	West'gh, "CCL," 220-440 v.	1120
1 30	Gen. Elec., Form "A," wound rotor.	900
1 30	Allis-Ch. 220-440 v.	850
5 35	Western El., type "CS," 220-440 v.	900
4 35	Allis-Ch., 220-440 v.	850
1 35	Gen. Elec., form "K," 220-440 v.	600
1 40	Fairbanks, M., type "B," 220 v.	1200
1 40	Fairbanks, M., 220 v.	900
1 40	Gen. Elec., form "A," wound rotor, 220 volt.	900
12 40	West'gh, type "CX," 220-440 v.	850
1 40	Allis-Ch., 220-440 v.	850
4 50	Gen. Elec., "KO," 220-440 v.	900
1 50	Allis-Ch., 220-440 v.	850
13 50	West'gh, "CX," 220-440 v.	850
2 50	Gen. Elec., Form "K," 220 v.	720
6 55	Gen. Elec., Form "K," 220-440 v.	514
1 50	West. Elec., "CS," 220-440 v.	900
2 75	West'gh, "CX," 220-440 v.	850
1 100	Gen. Elec., Form "L," 220-440 v., (wound rotor)	900
1 100	Gen. Elec., form K, 220 v.	720
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K.W.	Make	Volts	Ph.	Engine Description
600	Gen. Elec.	440	3	to 32x48 Allis H. D. Corliss
500	All.-Ch.	2300	3	to 16&32x48 Allis Cor. Tand. Comp.
3—500	Gen. Elec.	2300	2or3	to Gen. Elec. Steam Turbines
400	Gen. Elec.	2300	2or3	to 15&30x30 MacI. & S. V.C. Comp.
312	Westge.	220	2or3	to 20x36 Hamilton Hor. R.H. Corliss
3—300	Westge.	2300	2or3	to 24x30 Fitchburg 4 Valve
240	Gen. Elec.	440	3	to 17x21 Buckeye R.H. Eng.
200	All.-Ch.	2300	3	to 16x36 Allis Simple Corliss
175	West. Elec.	220-480	3	to 18x22 Fulton Cor. Valve
135	Westge.	440	3	to Westge. 3 Cylinder Vert. Gas
110	All.-Ch.	2200	2	to 16x14 Ideal Automatic
75	Cr.-Wh.	2300	2or3	to Fairbanks M. 3 Cyl. Gas Engine
75	Westge.	2400	3	to 13x14 Automatic Enclosed Engine
75	West. Elec.	2300	3	to De Laval Hor. Steam Turbine
2— 75	Westge.	2200	2	to 12&20x12 Westge. Vertical
60	Westge.	220	3	to 12x12 Fleming Automatic
50	Cr.-Wh.	2300	3	to Fairbanks M. Hor. Oil Engine

Other Sizes—Also A.C. & D.C. Belted Dynamos, Motors, ENGINES—BOILERS—ROTARIES—ELECTRIC CARS, Etc. Write Us.

FOR SALE

Rotary Converter

for picture machine. Holtzer-Cabot, D.C., 1450 R.P.M., 500 V., Type E, 4½ H.P., direct to, volts 100, 26 Amps. D.C. Price $125.00.

HOIST MOTOR

G. E., three phase, 220 V., 18 H.P., 720-670 R.P.M., 60 cycles, with Grids and reversing drum controller, $200.00.

220 V., D. C., G. E. GENERATOR

12½ K.W., Form H, Amps. 50, 1240 R.P.M., $150.00.
The above are excellent machines.

J. L. GLEASON & CO.
128 Summer Street **Boston, Mass.**

Hudson Terminal Building **Duzets & Son** **New York**

SPECIALS

300 K.W. Bullock, 600 RPM, alternator (3 ph., 60 cy., 2300 volt).
200 K.W. G. E., type "ATB," form "P," 600 RPM. alternator (3 ph., 60 cy., 2300 volt).
100 K.W. G. E., type "ATB," form "D," 900 RPM. alternator (3 ph., 60 cy., 220 volt).
125 H.P. and 75 H.P. Wghse. 3 cyl. engine (gas).
50 H.P. and 30 H.P. Meitz & Weiss engine (oil).
32 H.P. and 15 H.P. De La Vergne engine (oil).
17 x 24 Erie Ball, 4 valve engine.
16 x 36 Hughes & Phillips Corliss engine.
125 K.W. Crocker Wheeler, 125 volt dynamo. dir. con. Allis Corliss cross comp. engine.

Wanted—Brush Arc Lamps

For ½" round carbons, 9.6 amperes, 2000 candle power. Either form 2 or 31. 50 to 100 required. Must be in good working order.

HENRY FRANK, Jr., 374 Hudson Street, New York

75 K.W. 2 Phase, 60 Cycle, 2200 volt Westinghouse belted Generator with exciter. In good condition. Price $350.00

SPECIAL PRICES ON DIRECT CURRENT MOTORS

MILLER-OWEN ELECTRIC CO., Inc.
217-219 First Avenue **Pittsburgh, Pa.**

Commonwealth Edison Company.

Repair Shops

Telephone Randolph 1280
38 North Market Street, Chicago

Dynamos. Motors. Transformers.
Arc Lamps and Appliances
High grade machine work of all kinds
Correspondence Solicited-

GENERATOR FOR SALE

200 KW Fort Wayne, 250 volt, D. C. generator, direct connected to a 6 stage Kerr Turbine non-condensing, 2000 RPM.

Will sell cheap before removal.

JAMES K. HOOPER, 5 Beekman Street, New York City
Telephone Cortlandt 8251.

TWO 400 KW TURBINES

2-400 KW WESTINGHOUSE HORIZONTAL CONDENSING
60 CY 3 PH 440 OR 2300 V.T. WITH CONDENSERS
PUMPS-EXCITOR—UNIT---QUICK SHIPMENT

YOU CAN SAVE 50% IN PURCHASE OF A-1 APPARATUS
PAUL STEWART & CO. CINCINNATI, O.

FRANK MACGOVERN, Pres.-Gen. Mgr. **JOHN MAYER, JR., Vice-Pres.-Treas.**

MACGOVERN AND COMPANY, Inc.

114 Liberty Street, New York City **'Phone 3375-3376 Rector**

The undernoted motors are all in first class condition and guaranteed. They are ready for immediate shipment and can be inspected in our shops.
They are offered at exceptionally low prices.

ALTERNATING CURRENT MOTORS—60 CYCLE.

1	250	HP., Gen. Elec., 2300 volts, form K, 600 RPM.
1	200	HP., Gen. Elec., 220 volts, form K, 600 RPM.
1	100	HP., Westinghouse, 440 volts, form CCL., 850 RPM.
1	85	HP., Gen. Elec., 2080 volts, form I-K., 720 RPM.
1	75	HP., Westinghouse, 200 volts, form CCL., 1120 RPM.
1	75	HP., Westinghouse, 440 volts, form CCL., 1120 RPM.
1	75	HP., Gen. Elec., 220 volts, form M., 1200 RPM.
1	75	HP., Gen Elec., 220 volts, form L., 720 RPM.
1	75	HP., Allis-Chalmers, 1100 volts, 680 RPM.
4	50	HP., Gen. Elec., 2200 volts, form K., 900 RPM.
1	50	HP., Gen. Elec., 220 volts, form K., 900 RPM.
1	50	HP., Gen. Elec., 220 volts, form C., 720 RPM.
2	40	HP., Westinghouse, 220 volts, form C., 850 RPM.
1	35	HP., Gen. Elec., 220 volts, form K., 900 RPM.
1	35	HP., Gen. Elec., 220 volts, form L., 900 RPM.
1	35	HP., Gen. Elec., 220 volts, form K., 1200 RPM.
1	35	HP., Westinghouse, 440 volts, form CCL., 850 RPM.
1	30	HP., Westinghouse, 220 volts, form CCL., 1120 RPM.
1	25	HP., Westinghouse, 200 volts, form CCL., 850 RPM.
1	22	HP., Gen. Elec., 220 volts, form ITC.
1	20	HP., Gen. Elec., 220 volts, form L., 900 RPM.
1	20	HP., Westinghouse, 200 volts, form C., 1120 RPM.
1	20	HP., Westinghouse, 550 volts, form HF., 850 RPM.
1	16	HP., Westinghouse, 220 volts, form CCL., 1135 RPM.
1	15	HP., Allis-Chalmers, 220 volts, 1130 RPM.
1	15	HP., Gen. Elec., 220 volts, form L., 1200 RPM.
2	10	HP., Gen. Elec., 110 volts, form L., 1200 RPM.
1	10	HP., Gen. Elec., 220 volts, form K., 900 RPM.
1	10	HP., Gen. Elec., 220 volts, form C., 1800 RPM.
1	7½	HP., Gen. Elec., 220 volts, form K., 900 RPM.
1	7½	HP., Western Elec., 110 volts, form CL., 1800 RPM.
1	7½	HP., Allis-Chalmers, 220 volts, 1130 RPM.

Also smaller sizes. All complete with rails or bases and pulleys and starters if required.

DIRECT CURRENT MOTORS—250 VOLTS.

1	175	HP., Western Elec., type L5B., 525 RPM.
1	100	HP., Crocker-Wheeler, type CCM., 590 RPM.
1	90	HP., Bullock, 1000 RPM.
2	75	HP., Crocker-Wheeler, type CCM., 530 RPM.
4	60	HP., Crocker-Wheeler, type CCM., 830 RPM.
1	60	HP., Crocker-Wheeler, type CM., 830 RPM
1	60	HP., Gen. Elec., type DLC., 700/800 RPM.
1	55	HP., Gen. Elec., type CL-A., 845 RPM.
4	50	HP., Crocker-Wheeler, type D., 625 RPM.
1	40	HP., Westinghouse, type S., 936 RPM.
1	40	HP., Western Electric, type GL., 525 RPM.
1	40	HP., Western Electric, type GM., 800 RPM.
6	35	HP., Crocker-Wheeler, type I., 700 RPM.
1	30	HP., Crocker-Wheeler, type CM., 770 RPM.
3	25	HP., Crocker-Wheeler, type I., 750 RPM.
1	25	HP., Crocker-Wheeler, type I., 950 RPM.
2	25	HP., Gen. Elec., type CL-B., 725 RPM.
1	22	HP., Westinghouse, type SA., 1250 RPM.
7	15	HP., Gen. Elec., type CQ., 625 RPM.
13	15	HP., Crocker-Wheeler, type I., 800 RPM.
1	15	HP., Gen. Elec., type CE., 1100 RPM.
1	13	HP., Westinghouse, type S., 875 RPM.
2	10	HP., Westinghouse, type M., 750 RPM.
1	10	HP., Crocker-Wheeler, type CM., 1100 RPM.
7	10	HP., Crocker-Wheeler, type I., 825 RPM.
2	10	HP., Crocker-Wheeler, type I., 850 RPM.
2	7½	HP., Crocker-Wheeler, type F., 740 RPM.
6	7½	HP., Crocker-Wheeler, type F., 875 RPM.
3	5	HP., Gen. Elec., type CQ., 1100 RPM.
1	5	HP., Westinghouse, type M., 950 RPM.
4	5	HP., Gen. Elec., type F., 1000 RPM.
5	5	HP., Gen. Elec., type F., 950 RPM.
1	5	HP., Gen. Elec., type F., 980 RPM.

Also smaller sizes.
All complete with starters, pulleys and bases or rails.

SEND FOR SPECIAL LIST OF 25 CYCLE MOTORS, WHICH, FOR LACK OF SPACE, WE DO NOT LIST HERE. ALSO SEND FOR OUR GENERAL LIST OF STEAM AND ELECTRICAL APPARATUS, JUST OUT.

TURBO GENERATOR UNIT

1—400 KVA, Westinghouse Parsons, 3 phase, 60 cycle, 440 V., 3600 RPM., Turbine with Dean air pump and vacuum pump, practically new, can be rewound for 2300 volts.

DIRECT CONNECTED A. C. UNITS

1—200 KW., 3 phase, 60 cycle, 2300 Volts, 150 RPM., Bullock alternator to a 16 x 36 (Reliance) Allis-Chalmers-Corliss engine, without exciter.
1—125 KW., 3 phase, 60 cycle, 2200 Volts, 450 RPM., Westinghouse alternator to a Williams engine, complete with exciter.
1—75 KVA, 3 phase, 60 cycle, 2300 volts, Crocker-Wheeler generator to 13x12 Harrisburg engine.

BELTED ALTERNATORS

1—225 KVA., 2300 V., 3 phase, 60 cycle, 720 RPM., Westinghouse revolving field alternator, complete with exciter.
1—150 KW., 2300 V., single phase, 60 cycle, 920 RPM., revolving field Westinghouse alternator, complete with exciter.
1—150 KW., 2 or 3 phase, 60 cycle, 2300 V., 600 RPM., Fort Wayne alternator, revolving field, complete with exciter.
1—100 KW., 3 phase, 60 cycle, 2300 V., 900 RPM., type ATB, General Electric alternator (box frame type) Form P, complete with exciter.
1—75 KW., 3 phase, 60 cycle, 2300 V., 1200 RPM., type ATB, Fort Wayne (General Electric) alternator, with exciter.
1—30 KW., 250 V., 1200 RPM., 3 phase, 60 cycle, Western Electric alternator with exciter.
1—50 KW., 220 volt, 1200 RPM., 2 phase, 60 cycle, revolving field, Westinghouse alternator, complete with exciter.
1—30 KW., 3 phase, 60 cycle, 2200 volts, 1200 RPM., type ATB, Form P, General Electric alternator, complete with exciter.

VOLTAGE REGULATORS

6—25 Amp. IRS (USED)
3— 50 Amp. } IRS (NEW)
3— 75 Amp. } IRS (NEW)
5—100 Amp. } IRS (NEW)
2—150 Amp. } IRS (NEW)

General Electric Induction Regulators, 2300 volt, 10% buck and boost with all accessories.

FREQUENCY CHANGERS

4—450 HP., 3 phase, 25 cycle, 2300 Volt, 720 RPM., Westinghouse motors direct connected to 300 KW., 2300 V., 60 cycle, 720 RPM. Westinghouse alternators.

25 CYCLE TRANSFORMERS, SUITABLE FOR 60 CYCLES

10—150 KVA., 2300 V., to 10,000 V., Westinghouse transformers.
8—125 KW., 2300 V., to 11,000 V., Westinghouse transformers.
8—110 KW., 2300 V., to 11,000 V., Westinghouse transformers.
6—100 KW., 2300 V., to 11,000 V., Westinghouse transformers.
8—200 KW., 1150-2300 V., to 9900-11,000 V., Gen. Elec. transformers.

EXCITER SETS

2—40 HP., 200 volts, 710 RPM., 3 phase, 25 cycles, type CX, Westinghouse motors, direct connected to 25 KW., 125 volt, type S generators.

We carry a large stock of motors, generators and direct connected sets of all kinds. Let us have your inquiries. **Send for Catalog.**

GEO. SACHSENMAIER & COMPANY
143 N. 3rd Street, PHILADELPHIA, PA.

WHO WILL FINANCE

one or more public utilities in small towns of less than 15000 population? Telephone, electric light and power, water.

An engineer with several years successful executive experience in the commercial department of one of the largest public utility companies wants financial support.

Only New York and other eastern propositions of merit considered.

Commercial Engineer, Box 2949 Electrical World

The Art of Buying

is as much a reality as is the Art of Selling. Advertising of the right kind helps the *buyer* as much as it does the seller.

The Electrical World service department helps advertisers prepare advertising copy of real interest and use to World readers.

The Service Department is ready to serve you without charge, Mr. Manufacturer.

Electrical World
239 West 39th Street, New York

SEARCHLIGHT SECTION

FOR SALE

Electric Light and Ice Plant

For Sale—Combined electric and ice plant in town of 1400 in Kansas; modern equipment, including 100 k.w. turbine and 10-ton ice machine; long franchise; population of 2500 can be reached with 16 mile transmission line; can give terms. Box 2925, Elec. World.

Engine and Generator for Sale

One Horizontal McIntosh and Seymour Tandem Compound Condensing Belted Engine 11" x 20" x 30" 240 H.P., 150 R.P.M., with belt; flywheel 32" face by 11 ft. diameter, weight 13000 lbs. One G. E. A.C. Belt Driven Three Bearing Generator A. T. B. 16-250-450-2300 3 phase 60 cycle. Above outfit in first class operating condition and could be delivered immediately. The American Railways Company, Witherspoon Building, Philadelphia.

Oil Engine for Sale

30 H.P. Foos oil engine, special electric type, with extra heavy flywheels. Used very little. For sale on account of changing to electric drive. Sumter Electrical Co., Sumter, S. C.

75 H.P. Induction Motor for Sale

75 H.P. G. E. A. C. Motor, 220-440 volts, 3 phase, 60 cycles, 900 RPM, Type I, Form L. Practically new. Bargain. Box 2924, Elec. World.

Generators for Sale

100 K. W. Westinghouse, 225 volt direct current generator, connected to Westinghouse Producer Gas Engine, with (Wood's) Producer; price, $2,000. 50 K. W. Westinghouse, 125 volt generator connected to Westinghouse Producer Gas Engine; price, $1,650. These Engines can be arranged to operate on Natural, Illuminating, Gas or Gasoline. Units are in perfect running condition. Also large stock of Motors, other Electrical and Steam Machinery. Jefferson Machinery Co., Dealers in All Kinds of Second-hand Machinery, 546 West 45th St., New York City.

Motor for Sale

20 H. P., 550 volt, 3 phase, 60 cycle, Crocker-Wheeler motor, complete with pulley, base and starting box. Used less than six months. New bearing boxes. Price $200.00 f. o. b. Gardner, Mass. 190 K. W., 550 D. C. Triumph Generator, 520 RPM, with pulley, base and rheostat. Price, $1,000, f. o. b. Gardner, Mass. Gardner Electric Light Company, Gardner, Mass.

Turbine for Sale

300 K. W., 3 phase, 60 cycle, Westinghouse-Parsons outfit complete with condenser, vacuum pumps and all fittings, in excellent condition. Box 2741, Elec. World, Real Estate Trust Bldg., Philadelphia, Pa.

Lighting Unit for Sale

Complete lighting unit, consisting of a 120 hp Diesel Engine, direct connected to a Stanley 90 KW Generator, with exciter and Switchboard. Very low price lighting outfit for factory or large village. Address John N. Briggs, Coeymans, N. Y.

Pumps and Turbines for Sale

Two Worthington 1,500,000 gallons, horizontal, duplex power pumps, 14 in. diameter, 10 in. stroke; and two Houston 44 in. vertical turbines with bevelled gears, shafting, etc. Water & Light Commission, Fergus Falls, Minn.

FOR SALE

Generator for Sale

One 75-kilowatt, 250-volt, 760 rpm, compound wound, belted direct current Westinghouse generator. One Hoover, Owens, Rentschler, Simple Hamilton Corliss, 14" x 36" horizontal non-condensing engine. Apparatus complete with 10' x 19" fly wheel, rheostat, main switch, feed water heater, separator and steam trap. Vogt Manufacturing & Coach Lace Company, 408 St. Paul Street, Rochester, N. Y.

Generator for Sale

250 K. V. A. Allis-Chalmers Bullock generator, 3 phase, 60 cycle, 2300 and 4150 volts, 600 R.P.M., complete with base and pulley, exciter, rheostat and G. E. marble switchboard, with instruments and oil switch; all practically new; use terminated in order to purchase current. Despatch Heat, Light & Power Co., East Rochester, N. Y.

Boiler for Sale

150 H.P. boiler and stack, new feed pump, new heater, all new fittings; good grates, double door front, $500. Yates Center Electric Light Co., Yates Center, Kans.

Engine for Sale

One 20 H.P. two-cylinder No. 62 Nash gas engine, complete with batteries, etc.; in perfect running condition; $125; spot cash F. O. B. cars. Parks & Woolson Machine Co., Springfield, Vermont.

Fans

Brand-new Westinghouse 16", 110 V., 60 cycle, oscillating fans at 25% less than regular prices. If interested write to us. Geo. Sachsenmaier & Co., 145 N. 3d St., Philadelphia, Pa.

Calibrators, etc., for Sale

1 Type K M 2, Form SBA, Portable Watt Meter Calibrator, 110-220 Volt, 1-5-10-50-100 Ampere, 60 Cycle.
2 Portable Current Transformers, Type S, Cycles 25-140, 50 Watt, 150 Ampere, Ratio 30 to 1, 2200 volts.
1 Portable Watt Meter Calibrator, 220-440 volt, type K M-1, 60 Cycle.
1 Thompson DC Test Meter, Type CB3, Amp. 5-10-50-100, volts 110-220.
Above instruments made by G. E. & Ft. Wayne Companies, cost over $600.00—have never been on line. First wire acceptance subject to examination takes them at $350.00. Box 2934, Electrical World.

Transformers and Arc Lamps for Sale

Two 32 and one .15 K. W. series arc transformers and 115 series arc lamps, all in good condition. Inquire of A. Finley, Commissioner No. 2, Baker, Oregon.

Assignee Must Sell

Electric light plant, 20 year franchise, in good location. A good factory site, with 2 large 2-story buildings, located on main line of Frisco R. R. Address L. L. Thompson, Assignee, Lilbourn, Mo.

We buy anything that is metal. Write us what you have and get our quotations. Specialty of battery plants to dismantle anywhere.

National Metal & Rubber Co.

30 India Wharf, Boston, Mass.

FOR SALE

Stock for Sale

Triumph Electric Company's stock for sale. Inducements offered. Box 2803, Elec. World.

Transformer for Sale

One practically new Westinghouse Electric & Mfg. Co.'s Testing Transformer, rated at 10 KVA, single phase, 60 cycle, high tension voltage 5000, 10,000, 20,000, 25,000, 50,000; low tension voltage 110. Box 2944, Elec. World.

Turbines and Generators for Sale

35 K.W., 125 volt, Curtis Turbine, like new. 15 K.W., Terry Turbine, direct connected to Diehl generator; perfect condition. 100 K.W., 250 volt, belted generator General Electric. 85 K.W., Westinghouse, type S, belted generator, 250 volts. Will sacrifice. A. Werby & Co., 287 Atlantic Ave., Boston, Mass.

MISCELLANEOUS WANTS

Electric Light Plant Wanted

Will purchase electric light plant, city 1500 to 3500 population; location, West or Southwest. State price, K.W. rating, location, phase and cycles. Only property capable of expansion considered. Box 2929, Elec. World.

New Electrical Inventions

The Edison & Swan United Electric Light Co., Ltd., 36 Queen Street, London, England, are prepared to treat for inventions relating to electric lamps, instruments, fittings, etc.

Steam Turbine Wanted

Wanted to purchase, a second hand 500 kw, 2300 volt, 60 cycle, 3 phase steam turbine, complete with surface condenser, exciter, generator and exciter switchboard panels, and all necessary auxiliaries. The Albert Emanuel Company, 710 Schwind Building, Dayton, Ohio.

A. C. Generator Wanted

We are in the market for an alternating current generator, from 150 to 250 K.W., 3 phase, 60 cycles, about 240 volts. Curtis & Yale Co., Wausau, Wis.

To Copper Manufacturers

Englishman with offices City of London desires to represent first-class copper concern. Electrolytic wire bars, rods, wire, etc. Twenty years' practical experience in electric cable and allied trades, and personally well-known to leading European buyers. Address "Y. O.," care Street's, 30, Cornhill, London, England.

PROPOSALS

PROPOSALS FOR ELECTRIC LIGHTING

NOTICE TO CONTRACTORS.

MANSFIELD, OHIO,
June 16, 1914.

The date for receiving bids for furnishing electric street lights for the City of Mansfield, Ohio, will be changed from July 1, 1914, to August 1, 1914, as previously advertised.

The City of Mansfield.
By O. HURSH,
Director of Service.

SEARCHLIGHT SECTION

PROPOSALS

BOROUGH OF LANSDALE ELECTRIC LIGHT DEPARTMENT

LANSDALE, PA.

Care Mr. R. S. Landis, Chairman.

The above are soliciting sealed bids for the following supplies. Lump sum bids will not be considered. Bids will be opened July 1st, 1914:

Contract to be let for Mazda lamps:

4,000 ft. No. 2 B. & S. gauge 3 braid copper wire.

6,000 ft. No. 6 B. & S. gauge 3 braid copper wire.

3,000 ft. No. 8 B. & S. gauge 3 braid copper wire.

3,000 ft. No. 10 B. & S. gauge 3 braid copper wire.

2,000 lineal feet Washington fir cross arms 3¼ x 4¼.

500 cross arm braces, 1¼" x ¼" x 28" long.

1,000 carriage bolts ⅜" x 4" long.

600 steel pins ½" x 9½" long including 4½" locust wood tops.

All of the above iron material to be galvanized by the hot process.

2,500 ft. or in coil quantities ⅜ inch diameter arc lamp rope equal to Samson Spot cord.

2 barrels Kempo wedge knobs to take No. 14 and 12 wire.

Best discount on porcelain tubes in barrel lots.

6 Duplex mast arms 12 ft. long galvanized equal to the Puffalo Specialty Company's pattern.

The following pipe covering (equal to absestos sponge felt), with necessary brass bands for holding covering in position:

9 ft. 10 inch covering, 35 ft. 8 inch covering, 10 ft. 7 inch covering, 15 ft. 6 inch covering, 12 ft. 3 inch covering, 125 ft. 2 inch covering, 35 ft. 1½ inch covering, 15 ft. 1¼ inch covering.

Seven 100 lb. bags very best asbestos cement.

200 lb. asbestos mill board, ⅛ inch thick.

Price on poles, 8 inch tops, 25, 30 and 35 ft. chestnut, F. O. B. Lansdale.

"STATION EQUIPMENT FOR SALE"

OAK HARBOR, OHIO.

The Village of Oak Harbor has arranged to purchase current and the operation of its present electric lighting station will be discontinued about August 1, 1914. The entire equipment of the plant: Boiler, Engine, Arc and A. C. Generators, all accessories—will be sold to the highest bidder. Complete list of the equipment will be mailed to prospective bidders upon request to L. L. Carstensen, Clerk, Oak Harbor, Ohio.

LOUIS L. CARSTENSEN, Clerk.
Oak Harbor, Ohio.

TREASURY DEPARTMENT, SUPERvising Architect's Office, Washington, D. C., June 18, 1914.—Sealed proposals will be received at this office until 3 p. m., July 18, 1914, and then opened, for the installation complete of an electric passenger elevator, and a hydraulic lift, etc., in the extension to the United States post office and courthouse, at Guthrie, Okla., in accordance with the drawing and specification, copies of which may be had at this office in the discretion of the Supervising Architect. O. WENDEROTH, Supervising Architect. N. B.—Bidders are required to return the drawing and specification without marks, notes or other mutilations. The Government frank sent to intending bidders is to be used for the return of the drawing and specification, and for no other purpose.

Get your Wants into the Searchlight

ADVERTISING RATES

Positions Wanted, Evening Work Wanted, 2 cents a word, minimum charge 50 cents an insertion, payable in advance.

Positions Vacant, Salesmen Wanted, Agencies, all undisplayed Miscellaneous ads, Machinery and Plants For Sale (with one line of display heading), 3 cents a word, minimum charge $1.50 an insertion.

All advertisements for bids cost $2.40 an inch.

Advertisements in display type cost as follows for single insertions:

1-16 page, $6.25	1 in. single col., $4.00
1-8 page, 12.50	4 in. single col., 15.20
1-4 page, 25.00	8 in. single col., 29.20

In replying to advertisements, send copies of testimonials, etc., instead of originals.

PROPOSALS

STREET LIGHTING POSTS

NOTICE TO BIDDERS.

TUCSON, ARIZ.

Sealed bids or proposals will be received at the office of the City Clerk of the City of Tucson, up to 4 o'clock P. M. on Monday, July 6th, 1914, for sixty (60) or more Five (5) light and for twenty-six (26) or more one (1) light ornamental street lighting standards, without globes or bulbs, F. O. B. Tucson, Arizona.

The Five Light Standard shall be equipped with a terminal block for four (4) connections. The One Light standard shall be equipped with a terminal block for two (2) connections. Internal wiring arranged so that the lights shall be connected in series and each pole equipped with a porcelain series socket.

Each bidder shall submit his own designs and detail drawings to show connections and anchoring as well as all necessary information, such as height, weight, etc.

The proposals must be in a sealed envelope and shall be endorsed "Proposals for Ornamental Street Lighting Posts."

L. O. COWAN,
City Clerk.

POSITIONS WANTED

AUDITOR seeks engagement; fifteen years' public utility experience; familiar with modern accounting and systematizing and public service commission requirements; references A-1. Box 2930, Elec. World.

CAN YOU USE an expert? Wanted by an electrical heating engineer of proven ability and established reputation, a few accounts of manufacturers who are in need of such service in the development of heating appliances or the correction of defects in design and construction of present products. Box 2343, Elec. World, 1570 Old Colony Bldg., Chicago, Ill.

ELECTRICAL ENGINEER desires change; I have worked from the ranks, served for five years as shop foreman in building of dynamos and motors, also maintaining and repairing power plants; on the road for three years as construction engineer; office assistant for two years; will submit to an interview in Philadelphia or New York. Box 2926, Elec. World, Real Estate Trust Bldg., Philadelphia, Pa.

POSITIONS WANTED

DRAFTSMAN desires a position (24). Preferably in the East. Five years' experience on power station layouts and construction. References furnished. Box 2938, Elec. World.

ELECTRICAL engineering student, half through course, seeks employment with electrical, mechanical engineer or power house in or near New York. Box 2950, Elec. World.

ELECTRICAL Superintendent; technical graduate, Westinghouse engineering apprentice and draftsman; seven years' experience as sales and construction engineer, supervising installations and reconstruction power and lighting plants. Member A. I. E. E.; age 32, married. Best references. Box 2902, Elec. World.

ELECTRICAL engineer, technical graduate, 2 years central station engineer, mechanical, electrical; 1 year distribution engineer; 4 years' office design and 3½ years' field construction of power houses, substations and transmission lines (underground and overhead), desires position, East or Middle West; $160 per month; age 32, married; at present employed. Box 2914, Elec. World.

ELECTRICAL and mechanical engineer, now holding a responsible position, high class, desires to make a change. Would like to secure a position as superintendent or manager of a public utility property. Am married, can give first class references as to past performances. Box 2937, Elec. World.

EXPERIENCED central station manager wants position; present location ten years, with previous road and test experience; successful in overcoming adverse public sentiment and handling critical situations; age 33, married, located in South; will go anywhere; competent; thorough, efficient and result getter. If you have an opening let me correspond with you and present my record. Box 2888, Elec. World, 1570 Old Colony Bldg., Chicago, Ill.

DRAFTSMAN, mechanical and electrical, 7 years' experience, motor and generator, automatic machinery design, shop experience, German, technical graduate, wishes position. Box 2951, Elec. World.

FIRST CLASS power cable splicer and his helper desire steady positions; willing to go anywhere; can splice hot cables of all kinds; references furnished. Box 2932, Elec. World.

FOREMAN—Meter department foreman wants larger department, electric or gas and electric. Have college training and have specialized in meter work. Experience covers seven years with large gas and electric companies as foreman. Can show results in managing department where high efficiency and low costs count. Married, age 30. Best of references from past and present employers. Box 2939, Elec. World.

HEATING device designer desires to change position; experienced, reliable, ambitious, best references; location immaterial. Box 2495, Elec. World.

HIGH-GRADE manager of railroad and public utilities property open for engagement. Desire to change on account of climate. Box 2947, Elec. World.

SEARCHLIGHT SECTION

POSITIONS WANTED

I CAN POSITIVELY make your big business bigger; prefer a lighting fixture or electrical company; I am an electircal engineer, an efficiency expert, a trained mechanician with practical experience in economical shop practice, possess initiative and executive ability out of the ordinary; have valuable bank connections, at present actively engaged, but desire broader field; I can increase your production, likewise your profits; my past record proves me a money maker; my present associates will tell you I am a big producer. If you have been seeking one who can build up a sick business organization and put it on a quick healthy foundation, you need me; what I want is the biggest kind of responsibility with corresponding remuneration; the balance I unequivocally guarantee. Box 2940, Elec. World.

MANAGER central station; technical graduate, wide experience in new business methods and construction; age 35, married; $3,000. Box 2896, Elec. World.

NEW business man, successful record, technical training, seeks change; competent general manager or sales manager of central station. Box 2283, Elec. World, 1570 Old Colony Bldg., Chicago, Ill.

POSITION wanted with reliable firm by an electro-mechanical designer of window and exterior advertising novelty devices. Ten years cosmopolitan experience. Box 2907, Elec. World.

POSITION wanted as manager of gas or electric company in town of five to ten thousand; will go anywhere; good executive, able to meet and satisfy the public; sufficient engineering ability to handle operating end and curtail expenses; capable of laying out plans and securing business; previous experience. Box 2811, Elec. World, 1570 Old Colony Bldg., Chicago, Ill.

SALES ENGINEER, technical graduate, four years' experience selling and sales managing in middle and far west, now holding position in new business department of large eastern central station, desires connection with first class manufacturer as special representative or sales manager. Headquarters preferably New York City or vicinity. Box 2942, Elec. World.

SUPERINTENDENT and electrical engineer; age 35; desires location Central or Western State; extensive experience in supervising construction and operation of A.C. high tension and D.C. lighting and power systems; general public utility experience; A-1 references. Box 2941, Elec. World.

SUPERINTENDENT — Position wanted as superintendent of electric light and water works system by first-class central station operator. Best of references. Box 2906, Elec. World.

SUPERINTENDENT — Position wanted as superintendent, electrician or chief engineer of medium sized plant; technical graduate; have been engineer of ice, light and water plants; experienced with A. C. and D. C. switchboards, meters, wiring, linework, motors, telephones and storage batteries; excellent references. Box 2904, Elec. World, 1570 Old Colony Bldg., Chicago, Ill.

POSITIONS WANTED

SUPERINTENDENT — Position wanted as superintendent of power plant in small town; 6 years' experience with engines, turbines, air compressors, pumps, boilers, dynamos, line work, wiring, etc.; age 29, married; present salary $85 per month. Box 2905, Elec. World, 1570 Old Colony Bldg., Chicago, Ill.

TECHNICAL graduate desires position with railway or power company, in East or Middle West; 1½ years' experience testing large machines. Box 2916, Elec. World.

TECHNICAL GRADUATE, G. E. test; two years draftsman, power and substation design; three years general construction, stations, substations and high tension lines, would like to hear from operating or manufacturing concern who has live permanent opportunity to offer; South preferred but not essential. Box 2933, Elec. World.

POSITIONS VACANT

FOREMAN wanted to take charge of high tension ignition coil work; must be thorough and experienced; steady employment for the right man. Remy Electric Co., Anderson, Ind.

FINLAND

Yngre ingenior,

behärskande svenska och finska språken. med högskoleutbildning inom elektrotekniska och maskintekniska facken samt någon tids praktik i provrum och vid högspänningsanläggningar, erhaller genast anställning vid Kymmene bruk.

Anbud med vidimerade betygsavskrifter och meritförteckning samt angifvande av löneanspråk emotses till

Kymmene Aktiebolag,
Kuusankoski, Finland.

AGENTS AND SALESMEN

Do You Want N. Y. Representative?

Electrical engineering company, up on construction and repairs, with a corps of trained assistants and a modern 7 story building centrally located suitable for a storehouse, is desirous of hearing from some company desiring representation in New York City. Box 2923, Elec. World.

Agency Wanted

Able electrical engineer in New York will further the interests of either American or foreign concern. Box 2458, Elec. World.

AGENTS AND SALESMEN

Manufacturers' Agents Wanted

Manufacturer desires to establish selling agencies with manufacturers' agents calling on the electrical trade. We offer the complete Paul line of systems, water, electric light and power for city, country and suburban homes. Fort Wayne Engineering & Mfg. Company, Fort Wayne, Ind. Address Dept. H.

Manufacturer's Representative

Seeks new lines. Gentleman of wide experience in the railway field and with extended acquaintance among prominent people, desires to represent a few high grade manufacturers. Box 2948, Elec. World.

EMPLOYMENT AGENCIES

AMERICAN SERVICE COMPANY, Pittsburgh, Pa. Require for immediate proposals: Instructors in Electrical and Mechanical Engineering courses, $70-$150. Efficiency Engineer Gas-Oil-Electric Motor Manufacturing Works, $3000. Production Engineers, Electric Tools, $125. Traveling Sales Engineer, Electric Mining, $1800. Several experienced Head Electricians for large Engine Works, knowledge of cranes, magnets, etc., $125. Contractors General Electricians, experienced Lath and Bench work, $110-$125. Factory electricians, $70. Draftsmen on Power Houses, $100.

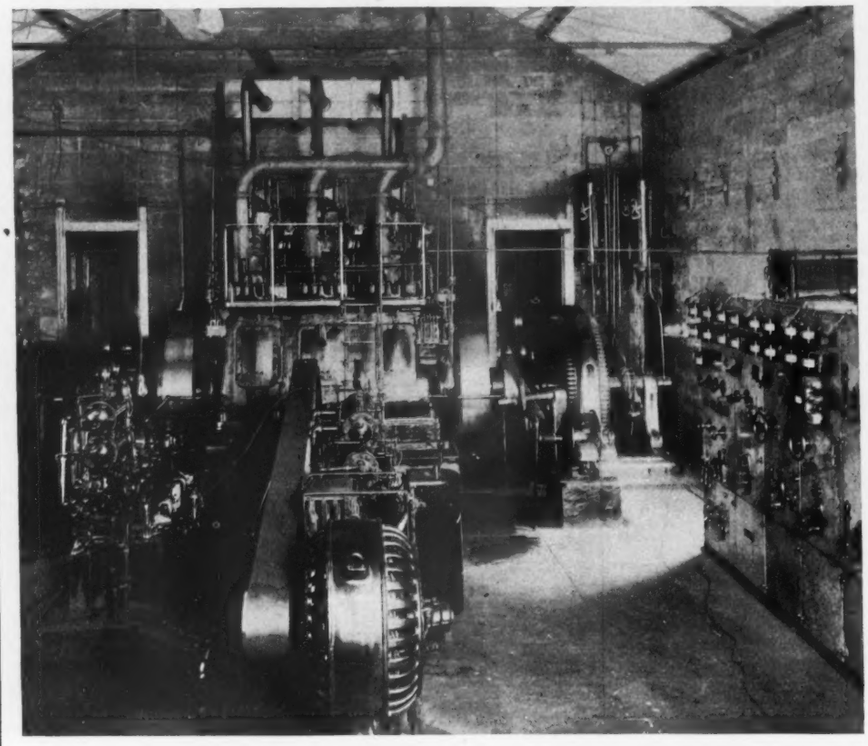
EDUCATIONAL

BLISS ELECTRICAL SCHOOL, Washington, D. C.—Condensed course in electrical engineering, complete in one year; thorough, practical, scientific; theoretical and applied electricity, mathematics, mechanical drawing and necessary engineering training; no superficial or non-essential studies; actual construction, installation and testing for young men of energy and character, twenty-second year opens Sept. 23. Write for catalogue. Address 129 Takoma Ave.

ROSE POLYTECHNIC INSTITUTE, Terre Haute, Indiana.—A college of engineering courses in mechanical, electrical, civil, chemical and architectural engineering; extensive shops, well equipped laboratories in all departments; expenses low; 31st year. For catalogue containing full information and professional register of alumni, address C. L. Mees President.

METERMEN WANTED to enroll for complete practical course on "Electrical Measuring Instruments and Meters." Endorsed by leading electrical men. Write for booklet, "Instruments and Meters," giving full information. Fort Wayne Correspondence School, No. 913 Shoaff Bldg., Fort Wayne, Ind.

RENSSELAER POLYTECHNIC INSTITUTE, TROY, N. Y.—Course in Civil, Mechanical, Electrical and Chemical Engineering and General Science leading to the degree of Civil Engineer (C.E.), Mechanical Engineer (M.E.), Electrical Engineer (E.E.), Chemical Engineer (Ch.E.), and Bachelor of Science (B.S.) Also special courses. Splendidly equipped new engineering laboratories. Send for catalogue to the Registrar.



"WE operate 42 arc lights, and a sewerage pump for the city, all the commercial and residence lights, two moving picture shows and a 40-ton ice plant, and our fuel consumption will run about 2,700 barrels of fuel oil per year."—Written after three purchases of DIESEL engines, bought in 1907, 1909, 1913.

10,000 BARRELS FUEL OIL SAVED

PER YEAR BY OUR

DIESEL ENGINES

"WE now have TWO 170 DIESELS and they operate a
20 - ton ICE PLANT, about
4,000 INCANDESCENT LAMPS,
22 ARC LAMPS for the city,
2 MOVING PICTURE SHOWS, and
75 ELECTRIC FANS, and our

fuel bill for the past year averaged but 200 barrels per month. We figure to carry our present load by steam would take at the *lowest* 1,000 barrels of oil per month, so that the DIESEL ***saves us*** some ***10,000 barrels*** of fuel per year.

"WE have two assistant engineers and one chief. It is their duty to look out for the machinery of the electric plant, as well as a 20-ton ice plant. We are now increasing the ice plant to a 40-ton output and the same crew will be able to care for it. ***One man runs the whole outfit at night.***

"The engines ***parallel perfectly,*** and we run one, two or three of them, just as our load demands. The one we installed seven years ago still ***maintains its efficiency*** and we have run it for ***six weeks*** at a time, day and night, ***without ever*** shutting it down."—*Written before their third purchase of DIESELS in 1913.*

The above statements were not made to us, but in letters to, and at the solicitation of, prospective purchasers of power equipment

BUSCH-SULZER BROS.-DIESEL ENGINE COMPANY

ST. LOUIS U. S. A.

READY-REFERENCE INDEX

to products manufactured by advertisers in this issue of Electrical World

Nearly 300 different products are here listed.

The Alphabetical Index (see fourth page following) gives the page number of each advertisement.

As far as possible advertisements are so arranged that those relating to the same kind of goods or apparatus will be found together.

This ready-reference index is up to date, changes being made each week.

If you don't find listed in these pages any electrical product of which you desire the name of the maker, write or wire Electrical World, and we will promptly furnish the information.

Air Compressors.
Allis-Chalmers Mfg. Co.
Murray Iron Works.
Platt Iron Works.

Aluminum.
Aluminum Co. of America.

Ammeters, Voltmeters.
(See Instruments, Electrical.)

Anchors, Guy.
Matthews & Bro., W. N.

Annunciators.
Ostrander & Co., W. R.
Western Electric Co.

Asbestos, Wood.
Johns-Manville Co., H. W.

Automobiles.
Baker Motor Vehicle Co.

Ball Bearings.
Hess-Bright Mfg. Co.
Norma Co. of America.

Batteries, Dry Cell.
Johns-Manville Co., H. W.
Manhattan Elec'l Supply Co.
Nungesser Carbon & Battery Co.

Batteries, Storage.
Edison Storage Battery Co.
Electric Storage Battery Co.
Gould Storage Battery Co.
Petschel Storage Battery Co.
Willard Storage Battery Co.

Battery Connections.
Fahnestock Electric Co.

Bells.
Manhattan Elec'l Supply Co.
Ostrander & Co., W. R.
Western Electric Co.

Belting.
Chicago Rawhide Co.

Binding Posts.
Fahnestock Electric Co.

Boilers.
Babcock & Wilcox Co.
Murray Iron Works.

Bolts, Expansion.
Hubbard & Co.

Books, Technical.
McGraw-Hill Book Co., Inc.

Boosters.
C. & C. Elec. & Mfg. Co.
General Elec. Co.
Triumph Electric Co.
Westinghouse Elec. & Mfg. Co.

Boxes, Fuse.
General Elec. Co.
Johns-Manville Co., H. W.
Matthews & Bro., W. N.
Metropolitan Eng'g Co.

Boxes, Junction and Outlet.
Chicago Fuse Mfg. Co.
Conn. Elec. & Mfg. Co.
D. & W. Fuse Co.
Johns-Manville Co., H. W.

Boxes, Meter and Service.
Johns-Manville Co., H. W.
H. Krantz Mfg. Co.
Metropolitan Eng'g Co.

Brackets, Pins, Etc.
Deal Lumber Co., L. K.

Brackets and Pins, Metal.
Hubbard & Co.
Pittsburgh Transformer Co.

Brushes, Dynamo.
Holmes Fibre Graphite Co.
Jeandron, W. J.
Le Valley Vitae Carbon B. Co.
Morgan Crucible Co., Ltd.

Building, Steel.
Blaw Steel Cons. Co.
Riter-Conley Mfg. Co.

Bushings.
Condit Electrical Mfg. Co.

Cable End Bells.
Electrical Engrs. Equip. Co.

Cable Joints.
G. & W. Electric Specialty Co.

Cable Racks.
Cope, T. J.

Cable Splicing Joints.
Matthews & Bro., W. N.

Cabling Machinery.
American Ins. Machy. Co.
New England Butt Co.
Torrington Mfg. Co.

Car Heaters, Electric.
Simplex Electric Heating Co.

Carbons.
Cary Co., Inc., Edw.
Graphite Metalizing Co.
Koerting & Mathieson Co., Inc.

Castings.
Pittsburgh Valve, F. & C. Co.
Triumph Electric Co.

Chains, Driving.
Link Belt Co.
Morse Chain Co.

Chandeliers.
Beardslee Chandelier Mfg. Co.
Benjamin Elec. Mfg. Co.
Goodwin & Kintz.

Circuit Breakers.
Condit Electrical Mfg. Co.
Cutter Co.
General Electric Co.
Machado & Roller.
Roller-Smith Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

Clamps.
Hickey & Schneider.

Clamps, Ground Connection.
Belden Mfg. Co.

Clamps, Guy.
Matthews & Bro., W. N.
Universal Cable Grip Co.

Cleats.
Blake Signal & Mfg. Co.
Colonial Sign & Ins. Co.
Imperial Porcelain Co.
National Metal M. Co.
Sears, Henry D.

Climbers.
Klein & Sons, Mathias.

Clips, Cable.
Matthews & Bro., W. N.

Clips, Testing.
Mueller & Co., R. S.

Clusters.
Benjamin Electric Mfg. Co.
Hubbell, Inc., Harvey.

Coils, Armature Field.
D. & W. Fuse Co.
Independent Lamp & Wire Co.

Coils, Choke.
General Elec. Co.
Railway & Industrial Eng. Co.

Coils, Induction.
Ostrander & Co., W. R.
Splitdorf Elec'l Co.
Western Elec. Co.

Coils, Spark.
Western Electric Co.

Commutator Truers.
Bryant Berry Stm. Turb. Co.
Jordan Bros.

Compounds, Boiler.
Dearborn Chemical Co.

Compounds, Commutator.
McLellan Co., K.

Condensers.
Allis-Chalmers Mfg. Co.
Platt Iron Works.
Westinghouse Machine Co.

Conduit Bends.
Fibre Conduit Co.

Conduit Fittings.
Gillette Vibber Co.

Conduit Rods.
Cope, T. J.

Conduits, Interior.
National Metal Moulding Co.
Tubular Woven Fabric Co.
Western Conduit Co.

Conduits, Underground.
Fibre Conduit Co.
Gest, G. M.
Johns-Manville Co., H. W.
Michigan Pipe Co.
National Conduit & Cable Co.

Connections and Terminals.
Elec. Engineers Equip. Co.

Controllers.
Allis-Chalmers Co.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Co.
Monitor Controller Co.
Simplex Electric Heating Co.
Ward Leonard Electric Co.
Westinghouse Elec. & Mfg. Co.

Conveying Machinery.
(Coal, Ashes, Etc.)
American Bridge Co.
Green Engineering Co.
Link Belt Co.
Morse Chain Co.
Northern Eng. Works.

Cord Adjusters.
American Vul. Fibre Co.

Cord, Arc Lamps.
Samson Cordage Works.

Cord, Flexible.
American Electrical Works.
Belden Mfg. Co.

Cord, Trolley.
Samson Cordage Works.

Counting Scales.
National Scale Co.

Couplings, Flexible.
Bruce-Macbeth Engine Co.
Smith-Serrell Co.

Crane Motors.
Triumph Electric Works.
Westinghouse Elec. & Mfg. Co.

Cranes, Traveling.
American Bridge Co.
Maris Bros.
Northern Engineering Works.

Cross-Arms.
American Bridge Co.
Barnes & Lindsley Mfg. Co.
Deal Lumber Co., L. K.
Riter-Conley Co.
Western Elec. Co.

Cutouts.
D. & W. Fuse Co.
G. & W. Electric Specialty Co.
Metropolitan Eng'g Co.
Sears, Henry D.

Dies.
Col's Die, Tool & Machine Co.

Disconnecting Switches.
General Devices & Fittings Co.

Drills, Brick.
Hubbard & Co.

Drills, Electric.
U. S. Elec'l Tool Co.

Drills, Hand.
Orr & Lockett Hardware Co.

Drills, Portable.
Stow Mfg. Co.

Dynamos and Motors.
Allis-Chalmers Mfg. Co.
Burke Electric Co.
C. & C. Elec. & Mfg. Co.
Century Electric Co.
Eck Dynamo Motor Co.
Electric Machinery Co.
Electro-Dynamic Co.
Emerson Electric Mfg. Co.
Engbergs Elec. & Mech. Wks.
General Electric Co.
Gregory Electric Co.
Hallberg, J. H.
Kimble Electric Co.
Lincoln Electric Co.
Northwestern Elec. Co.
Peerless Electric Co.
Reliance Elec. & Eng. Co.
Richmond Elec. Works.
Robbins & Myers Co.
Stow Mfg. Co.
Strelinger Co., Chas. A.
Triumph Electric Co.
Wagner Electric Co.
Westinghouse Elec. & Mfg. Co.

Electromagnets.
Acme Wire Co.
Cutler-Hammer Mfg. Co.
Elec. Controller & Mfg. Co.
Sundh Electric Co.

Elevators.
Link Belt Co.

Engineers, Consulting.
(See Directory of Engineers.)

Engineers, Contracting.
(See Directory of Engineers.)

Engines, Gas and Gasoline.
Allis-Chalmers Mfg. Co.
Bruce-Macbeth Engine Co.
Carlisle & Finch Co.
General Elec. Co.
Strelinger Co., Chas. A.
Westinghouse Mach. Co.

Engines, Oil.
Busch-Sulzer Bros.
Lyons Atlas Co.
McIntosh & Seymour Corp.

Engines, Steam.
Allis-Chalmers Mfg. Co.
Buckeye Engine Co.
McIntosh & Seymour Corp.
Murray Iron Works.
Westinghouse Mach. Co.

Experimental Apparatus.
Biddle, James G.
Machado & Roller.

Fan Motors.
Eck Dynamo & Motor Co.
Emerson Electric Mfg. Co.
Fidelity Elec. Co.
General Electric Co.
Peerless Electric Co.
Robbins & Myers Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Fans (Exhaust and Ventilating).
Emerson Elec. Mfg. Co.
Kimble Elec. Co.
Westinghouse Elec. & Mfg. Co.

Fibre (See Insulating Material).
American Vul. Fibre Co.
Continental Fibre Co.
Fibre Conduit Co.
Johns-Manville Co., H. W.

Field Coil Pads.
Mass. Chemical Co.
Walpole Tire & Rubber Co.

Financial.
Coal & Iron National Bank.
Electric Bond & Share Co.

Fire Extinguishers.
Pyrene Mfg. Co.

Fixtures, Electric and Gas.
Beardslee Chandelier Mfg. Co.
Beers Sales Co.
Benjamin Elec. Mfg. Co.
Goodwin & Kintz Co.
Johns-Manville Co., H. W.
Lighting Studios Co.
Multi-Lux Illuminating Co.
Wheeler Reflector Co.

Flashers.
Campbell Electric Co.

Friction Tape and Cloths.
Johns-Manville Co., H. W.

READY-REFERENCE INDEX

to products manufactured by advertisers in this issue of Electrical World

Massachusetts Chem. Co.
Walpole Tire & Rubber Co.

Fuses.
Chicago Fuse Mfg. Co.
Condit Elec. Mfg. Co.
D. & W. Fuse Co.
Daum Co., A. F.
Delta Star Elec. Co.
Economy Fuse & Mfg. Co.
General Electric Co.
Johns-Manville Co., H. W.
Metropolitan Eng'g Co.
Railway & Industrial Eng. Co.
Sears, Henry D.

Fuses, Refillable.
Monarch Refillable Fuse Co.

Fuse Boxes.
(See Boxes, Fuse.)

Gauges, Recording.
Bristol Co.
Industrial Instrument Co.

Gauges, Water Column.
Jenkins Bros.

Gears.
Chicago Rawhide Co.
New Process Gear Corp.

Glass.
Lippincott Glass Co.

Globes, Shades, Etc.
Cary Co., Edw. E.
Lighting Studios Co.
Lippincott Glass Co.

Graphite.
Dixon Crucible Co., Joseph.

Grinders, Electrically Driven.
U. S. Elec'l Tool Co.

Grounds, Etc.
Paragon Electric Co.

Guards, Inc., Lamps.
Hubbell, Inc., Harvey.
Matthews & Bro., W. N.

Hair Dryers.
Shelton Elec. Co.

Hangers, Cable.
Condit Electric Mfg. Co.
Matthews & Bro., W. N.

Head Gates.
American Bridge Co.

Heaters, Feed Water.
Platt Iron Works.

Heating Devices, Electric.
Cutler-Hammer Mfg. Co.
General Electric Co.
Hotpoint Electric Heating Co.
Simplex Electric Heating Co.
Westinghouse Elec. & Mfg. Co.

Heating, Steam.
American District Steam Co.

Hoists, Electrical and Steam.
Allis-Chalmers Mfg. Co.
Maris Bros.
Northern Engineering Works.

Ice Machines.
Carbondale Machine Co.
Johns-Manville Co., H. W.
United Ice Improvement Co.

Ignitors, Gas Engine.
Carlisle & Finch Co.

Indicator, Speed.
Biddle, James G.
Machado & Roller.

Injectors.
Jenkins Bros.

Instruments, Electrical.
Graphic.
Biddle, James G.
Bristol Co.
General Electric Co.
Keystone Electrical Inst. Co.
Westinghouse Elec. & Mfg. Co.
Indicating.
Eldredge Elec. Mfg. Co.
General Electric Co.
Hoyt Elec'l Instr. Co.
Kermel Apparatus Co.
Keystone Electrical Inst. Co.
Machado & Roller.
Roller-Smith Co.
Wagner Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Weston Electrical Instr. Co.
Integrating.
Biddle, James G.
Columbia Meter Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.
Scientific and Testing.
Biddle, James G.
Keystone Electrical Inst. Co.
Leeds & Northrop Co.
Matthews & Bro., W. N.

Insulating Cement.
Massachusetts Chem. Co.
Walpole Tire Rubber Co.

Insulating Machinery.
American Ins. Mach'y Co.
New England Butt Co.

Insulating Material.
China and Porcelain.
Colonial Sign and Ins. Co.
General Electric Co.
Imperial Porcelain Works.
Locke Insulator Mfg. Co.
Pittsburgh H. V. Ins. Co.
Thomas & Sons Co., R.
Compounds, Paints and Varnishes.
Electric Cable Co.
General Electric Co.
Massachusetts Chem. Co.
Walpole Tire & Rubber Co.
Composition, Cloth and Paper.
Siemens Hard Rubber Co.
Walpole Tire & Rubber Co.
Fibre.
Continental Fibre Co.
Diamond State Fibre Co.
Formica Insulation Co.
Johns-Manville Co., H. W.
Massachusetts Chem. Co.
Lava.
Steward Mfg. Co., D. M.
Mica.
Electric Service Co.
Jaroslaw, D.
Munsell & Co., Eugene.
Tape.
American Electrical Works.
Johns-Manville Co., H. W.
Massachusetts Chem. Co.
Okonite Company.
Walpole Tire & Rubber Co.

Insulator Clamps.
General Devices & Fittings Co.

Insulators.
China, Porcelain and Composition.
Anderson Mfg. Co., A. & J. M.
Colonial Sign & Ins. Co.
General Electric Co.
General Insulate Co.
Imperial Porcelain Works.
Locke Insulator Mfg. Co.
Mica Insulator Co.
Pittsburgh High Volt Ins. Co.
Sears, Henry D.
Thomas & Sons Co., R.
Glass.
Hemingray Glass Co.
Locke Insulator Mfg. Co.

Insulator Clamps.
Elec. Engineers Equip. Co.

Jig and Fixture Work.
Col's Die, Tool & Machine Co.

Lamps, Arc.
General Electric Co.
Koerting & Mathiesen Co., Inc.
Reisinger, Hugo.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Lamps, Flaming Arc.
General Electric Co.
Koerting & Mathiesen Co., Inc.
Reisinger, Hugo.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Lamp Guards.
McGill Mfg. Co.
Hubbell, Inc., Harvey.

Lamps, Incandescent.
Cons. Elec. Lamp Co.
General Electric Co.
Independent Lamp & Wire Co.
National Lamp Co.
Western Electric Co.
Westinghouse Lamp Co.

Lamps, Miniature.
General Electric Co.

Lamps, Replacers.
Matthews & Bro., W. N.

Lamps, Turndown.
General Elec. Co.
Wirt Co.

Lava.
(See Insulating Material, Lava.)

Lighting Companies.
Commonwealth Edison Co.

Lightning Arresters.
Delta Star Elec. Co.
General Electric Co.
Railway & Industrial Eng. Co.
Westinghouse Elec. & Mfg. Co.

Line Material.
Anderson Mfg. Co., A. & J. M.
Archbold Brady Co.
Electrical Engrs. E. Co.
G. & W. Elec. Specialty Co.
General Electric Co.
Johns-Manville Co., H. W.
Matthews & Bro., W. N.
Pacific Elec. & Mfg. Co.
Western Electric Co.
Westinghouse Elec. & Mfg. Co.

Linemen's Tools.
(See Tools, Linemen.)

Linemen's Shields.
Matthews & Bro., W. N.

Lockers.
Darby & Sons, Inc., Edw.

Lubricants.
Dearborn Chemical Co.
Dixon Crucible Co., Joseph.

Magnet Wire.
Acme Wire Co.
American Brass Co.
Belden Mfg. Co.
Benedict & Burnham Mfg. Co.
D. & W. Fuse Co.
Hazard Mfg. Co.
Independent Lamp & Wire Co.
Massachusetts Elec. Mfg. Co.
Western Electric Co.

Magnets.
Acme Wire Co.
Boker & Co., Hermann.

Magnets, Lifting.
Cutler-Hammer Mfg. Co.

Magnetos.
Splitdorf Electrical Co.

Mechanical Stokers.
Westinghouse Machine Co.

Medical Apparatus.
Manhattan Elec'l Supply Co.
Pignolet, L. M.

Meter Dials.
Premier Metal Etching Co.

Meter Testers.
States Company.

Mica.
Formica Insulation Co.
Jaroslaw, D.
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Pumps, Water Works.
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NOTICE TO ADVERTISERS:

Printing begins on Friday of each week.
Changes of copy received up to 10 A. M. Friday will appear in the issue of the following week, but no proofs can be submitted for OK before publication.
New Advertisements (not changes of copy) received up to Tuesday noon can appear in the issue of that week, but no proofs can be shown.
If proofs before printing are required changes of copy and copy for new advertisements must be in our hands two weeks in advance of the date of publication.

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Westinghouse Luxsolite Fixture

After careful consideration of the various makes of lamps and reflectors, the Board of Trustees of the Sanitary District of Chicago, has awarded to the Westinghouse Lamp Company, a contract for a minimum quantity of 2,000 and a maximum quantity of 10,000 lamps with suitable fixtures.

The lamps will be 600 candle power, 20 ampere, ½ watt per candle, Improved Westinghouse Mazda Street Series, and the fixtures will be Westinghouse Luxsolite copper cased with white porcelain surfaced reflectors fitted with a compensator for operating on a 6.6 or 10 ampere primary delivering 20 amperes to the lamp.

It is significant that the second city in the United States should so quickly decide to use the improved street series Mazda lamps and then specify, **Westinghouse** Lamps and **Westinghouse** fixtures.

It is another example of the confidence that discriminating purchasers have in electrical goods labelled "Westinghouse."

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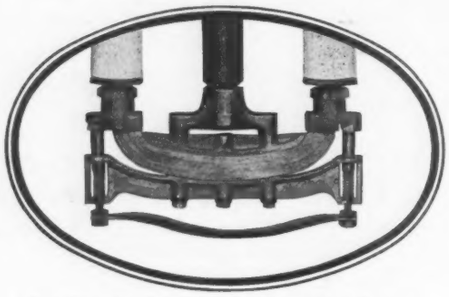
Member Society for Electrical Development. "Do it Electrically."

MAZDA guarantees your light

Reduce the equipment cost of your high capacity stations by using

Westinghouse Type E Oil Circuit Breakers

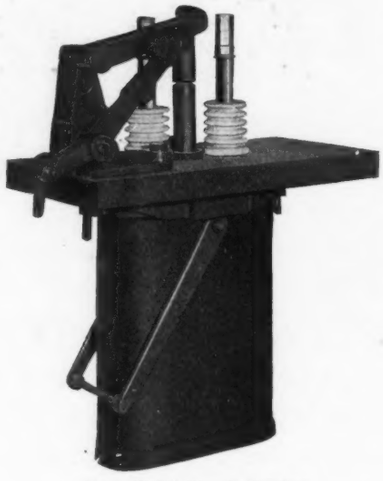
They do the work usually done by breakers of much larger size and higher price.



Butt-Type Laminated Brush with Arcing Contacts

The main contacts are of the butt laminated type, amply protected from arcing by renewable arcing contacts.

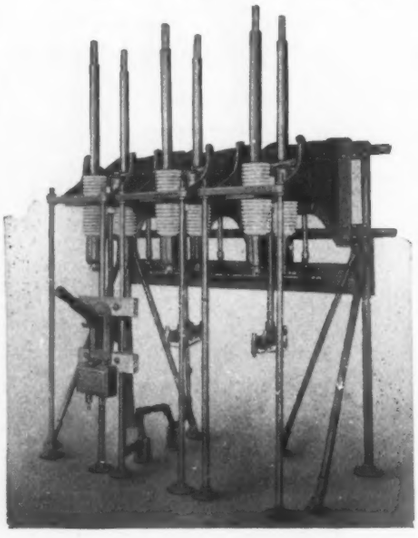
The insulators are of the heavy pillar porcelain type, clamped in position but readily removable. For high voltages they are reinforced by concentrated "Micarta" coated tubes.



Type E Oil Circuit Breaker
Single Pole Unit, for Cell Mounting

The tanks are elliptical in shape and deeper than usual, allowing greater head and volume of oil and greater space for gas expansion. Strong mechanical construction gives ample resistance to internal short-circuit stresses.

The wall or pipe frame mounting breaker has been adopted by many operators of large stations as more desirable for standard equipment than the older form of cell mounting. These breakers can, however, be supplied for either pipe frame or cell mounting.



Westinghouse Type E Oil Circuit Breaker for Wall or Pipe Frame Mounting

The maximum ratings are as follows:

Type E1—Small cell mounting breaker 300 and 600 amp. at 16,500 v.; 1200 amp. at 7500 v.; 3 phase; ultimate breaking capacity 10,000 kva.

Type E2—Large cell mounting breaker, 300 and 600 amp. at 35,000 v.; 1200 amp. at 25,000 v.; 2000 amp. at 15,000 v.; 3 phase; ultimate breaking capacity 20,000 kva.; 3000 and 4000 amp. at 15,000 v.; ultimate breaking capacity 30,000 kva.

Type E3—Small wall mounting breaker, same ampere and volt ratings as type E1 and in addition 3000 amp. at 750 v.; 3 pole only; 3 phase; ultimate breaking capacity 12,500 kva.

Type E4—Large wall mounting breaker, same ampere and volt ratings, excepting 4000 ampere, as type E2; 3 phase; ultimate breaking capacity 25,000 kva.

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Where these prospects are numerous and cannot be easily reached by solicitors, we have prepared circular letter campaigns to create inquiries. These campaigns are specially arranged to appeal to each separate group of prospects, and are so arranged that you can use them with the least expense and effort on your part. The handsome window card reproduced herewith can also be furnished.

2. *Proper installation*—We have prepared complete catalogues on these outfits which clearly indicate the proper type and size of fan to use for each installation, and these catalogues can be obtained on request. But where special cases arise we shall be glad to give you full assistance in selecting outfits so that the user will secure a satisfactory installation.

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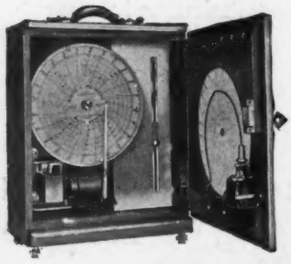

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